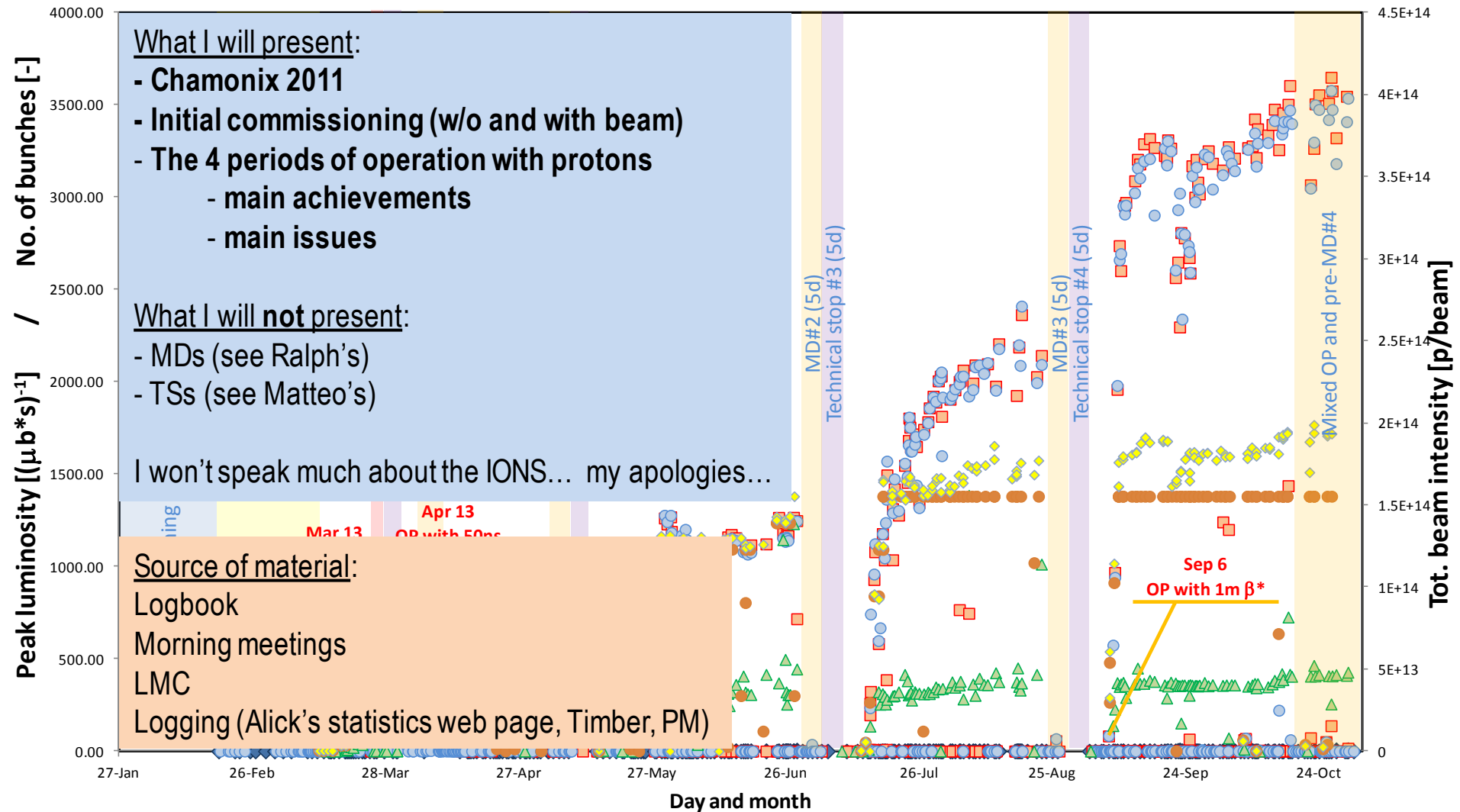


MIRKO POJER



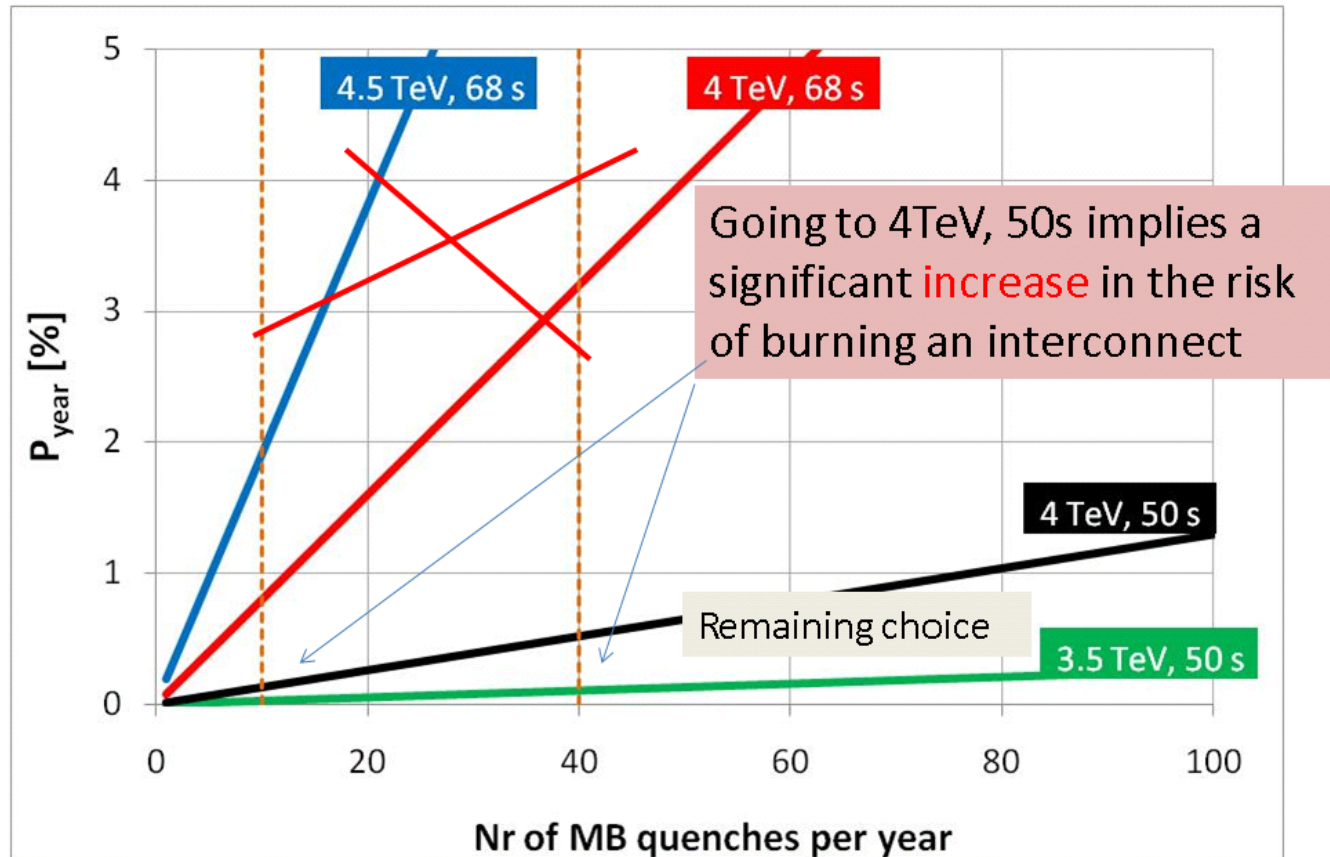
Introduction and review of the year including OP issues

Acknowledgements: The whole OP crew, machine coordinators, experts of different systems who involuntarily gave me material



(Probability) Maximum Safe Energy

Probability per Year of burning an interconnect



Proposal (later supported by Council): stay at 3.5 TeV and install the snubber capacitors everywhere!



Beam parameters 2011

@ exit SPS

Beam parameters	150 ns	75 ns	50 ns
Bunch intensity [e11 p/b]	1.2	1.2 (1-batch) 1.2 (2-batch) tbc	1.2 (1-batch) 1.6 (1-batch) 1.2 (2-batch)
Normalised Emittance [μm]	2 (1.6 achieved)	2 ~1. to 1.5 – <u>tbc</u>	2 3.5 ~1.5

Retained for L calculation (LHC):

Beam parameters	150 ns	75 ns	50 ns
Bunch intensity [e11 p/b]	1.2	1.2	1.2
Normalised Emittance [μm]	2.5	2.5	2.5
Colliding bunches	368*	936	1404

*assume 368 b as proven from 2010 - should be able to go to ~424 b

Estimated Peak and Integrated Luminosity

- **Baseline is 2E32 Peak and 1fb-1 (integrated)** (expectation management)
- But following 2010, we are confident we will do better

$\beta^* = 1.5\text{m}$

day s	H.F	Comm with	Fills with	kb	Nb e11	ϵ μm	ξ/IP	L Hz/cm ²	Stored energy MJ	L Int fb ⁻¹ 4 TeV	L Int fb ⁻¹ 3.5 TeV
160	0.3	150 ns	150 ns	368	1.2	2.5	0.006	~5.2e32	~30	~2.1	~1.9
135	0.2	75 ns	75 ns	936	1.2	2.5 2 1.8	0.006 0.007 0.008	~1.3e33 ~1.6e33 ~1.8e33	~75	~3 ~3.8 ~4.2	~2.7 ~3.3 ~3.7
125	0.15	50 ns	50 ns	1404	1.2	2.5	0.006	~2e33	~110	~3.2	~2.8

Possible integrated Luminosity of 2-3 fb-1



Goals for 2011



Proton running

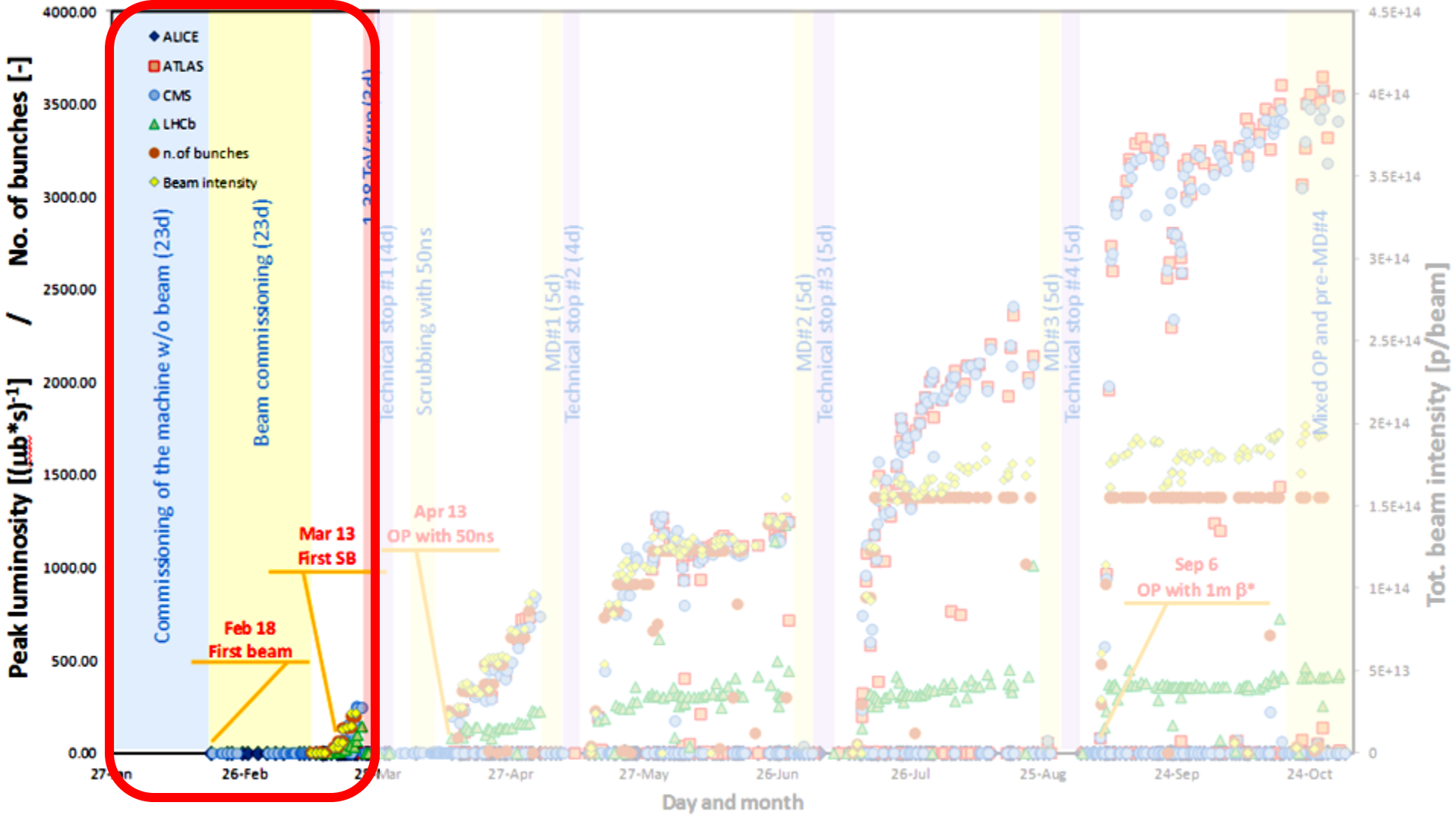
- Goal for 2011 was already set a year ago:
 - 1 fb⁻¹ delivered to each of IP1, IP5 and IP8 at 3.5 TeV (or >3.5TeV)

- Can probably do better for IP1 and IP5 Gimme five ... fb⁻¹ ?
 - You can make the SM Higgs visible or ... history

- But it will actually be a challenge to deliver 1fb⁻¹ to IP8
 - consider maximum luminosity and pile-up tolerable to LHCb
 - Already a big effort from LHCb side to “help” reaching the target:
 L_{max} : from 2e32 to 3e32 and μ_{max} : from 0.5 to 2.5
 - One fb⁻¹ will be just reachable if we make proper choices
 - with lumi leveling (no decay): $3e32 * 110 \text{ days} * 0.35 = 1 \text{ fb}^{-1}$

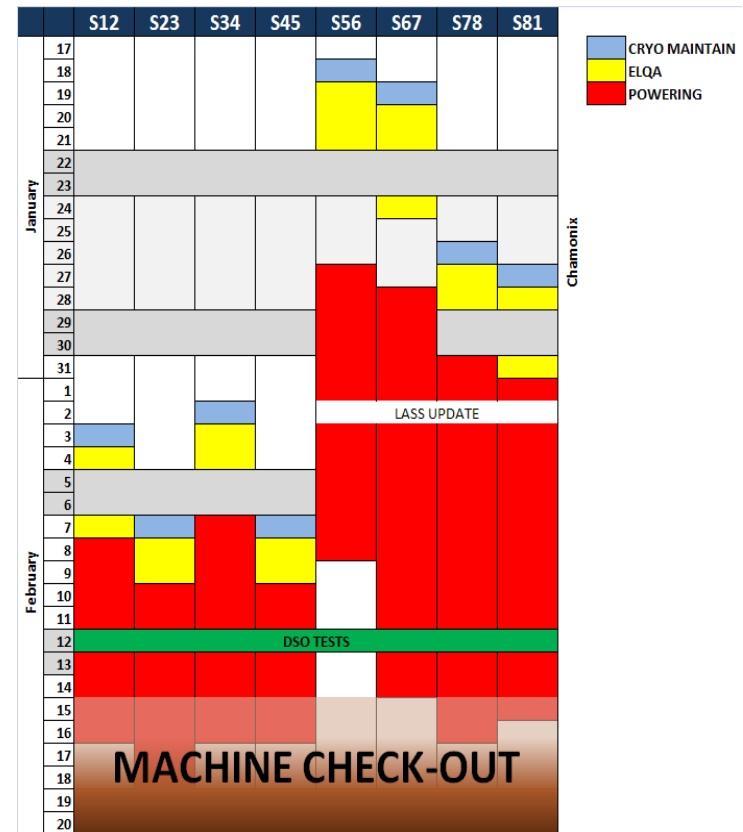
fraction in stable beams







- Snubbers installed and tested as requested by the management
- Powering tests completed in a record time (as planned!), on Friday 18th
 - About 6000 tests executed on the superconducting circuits
- Machine through nominal cycle during the night:
 - Pre-cycling of the magnets
 - Injection
 - Ramp
 - Squeeze
- Machine check-out carried out in the shadow, with close collaboration in the last few days (priorities defined together)

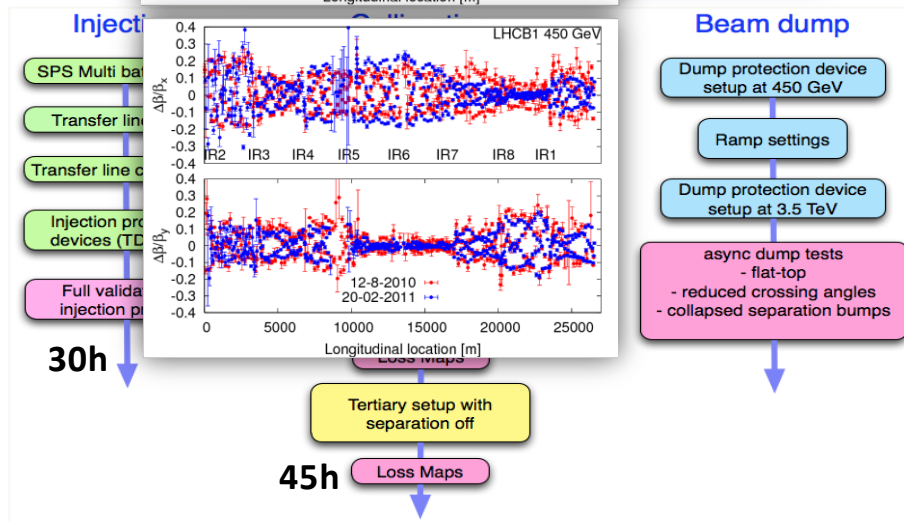
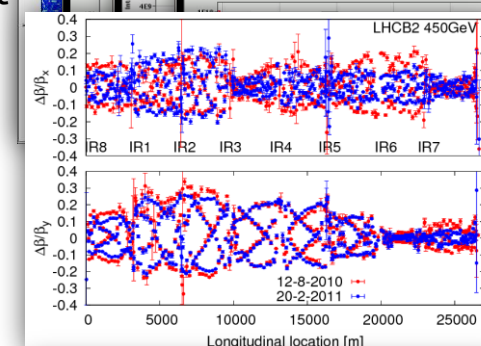
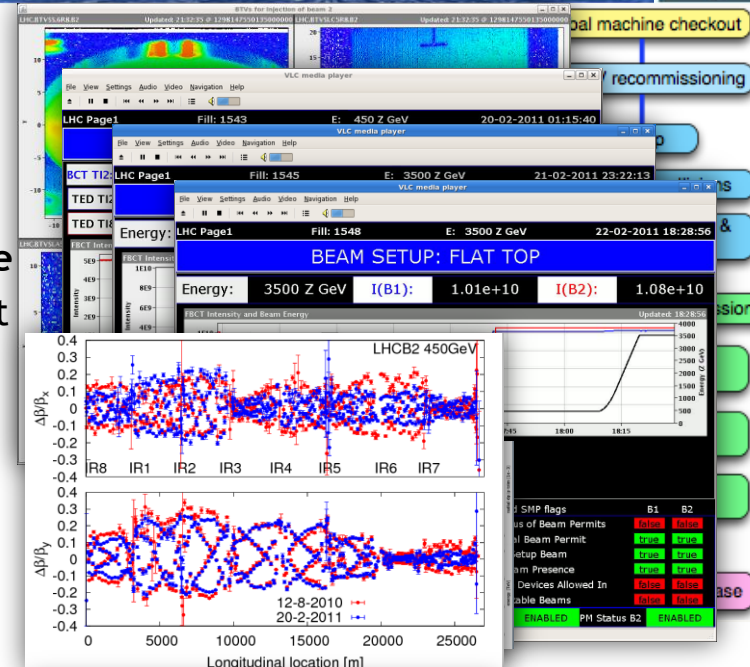




- **Very fast machine restart and ramp-up:**
 - Feb 20: both beams circulating
 - Feb 21: first ramp with OFB and QFB
 - Feb 23: first nominal bunches in
 - Feb 24: first ramp with dynamic reference change
 - Feb 25: first squeeze in 1 step to 1.5 m b*, without
 - Mar 5: first ramp with nominal bunches
 - Mar 8: 75ns-spaced 4b injection
 - Mar 10: collisions in all IPs
 - Mar 13 @18:04: first **STABLE BEAMS** with 3b
 - Mar 18: STABLE BEAMS with 32b
 - Mar 19: STABLE BEAMS with 64b
 - Mar 20: STABLE BEAMS with 136b
 - Mar 23: STABLE BEAMS with 200b

- **...though...**

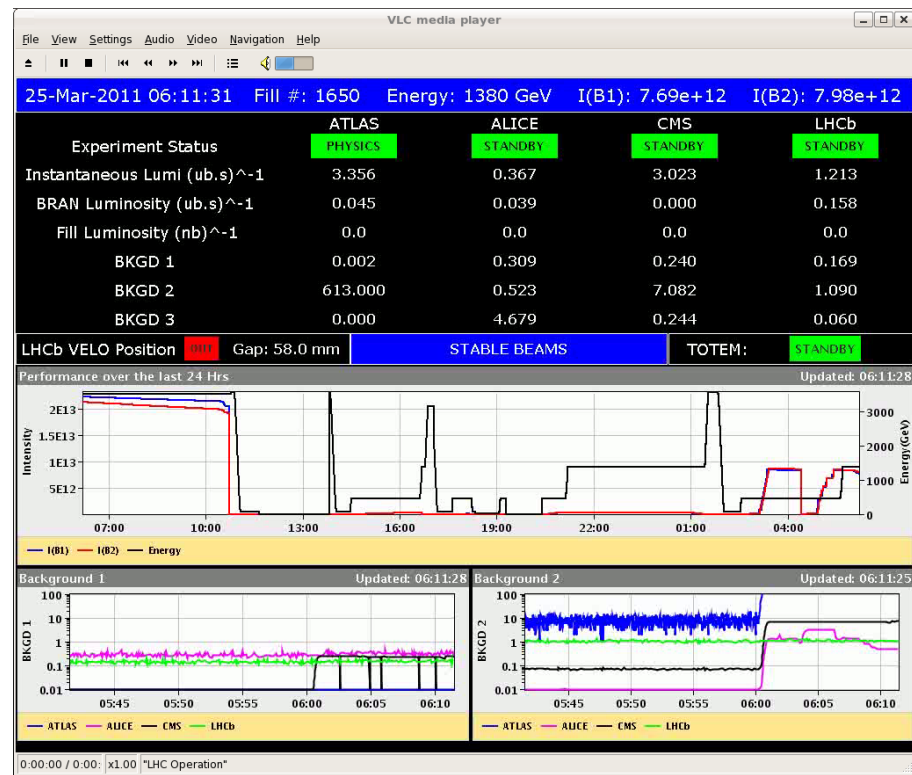
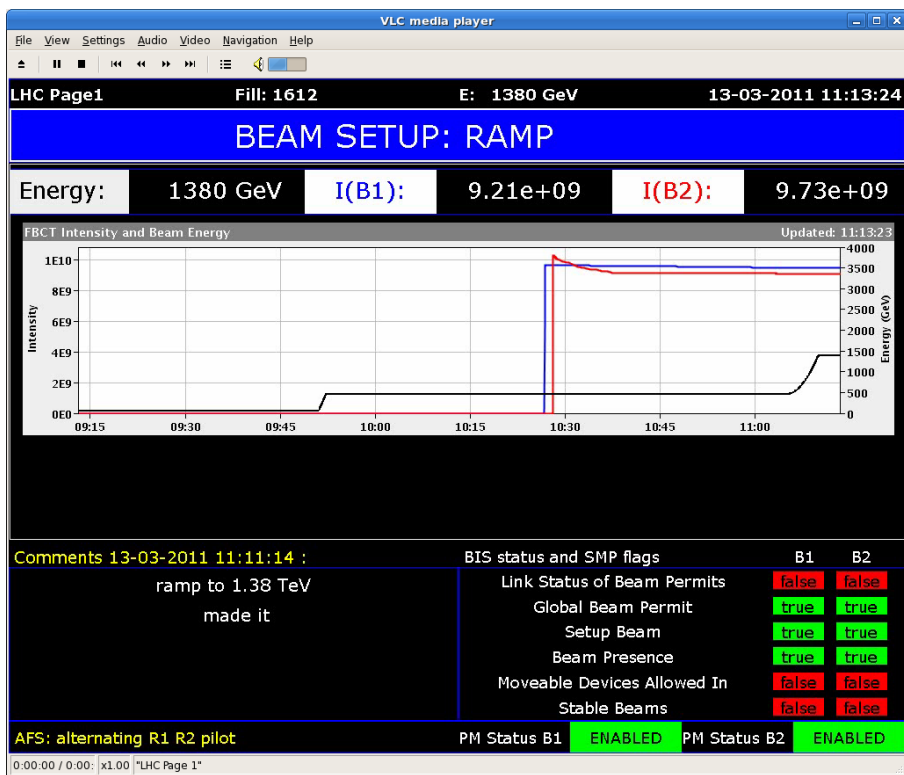
- **145h downtime:**
 - Converter trips
 - Glitches
 - Cryo-problems
 - QPS issues
 - FB-related trips (RQTD/Fs) - beam dumped

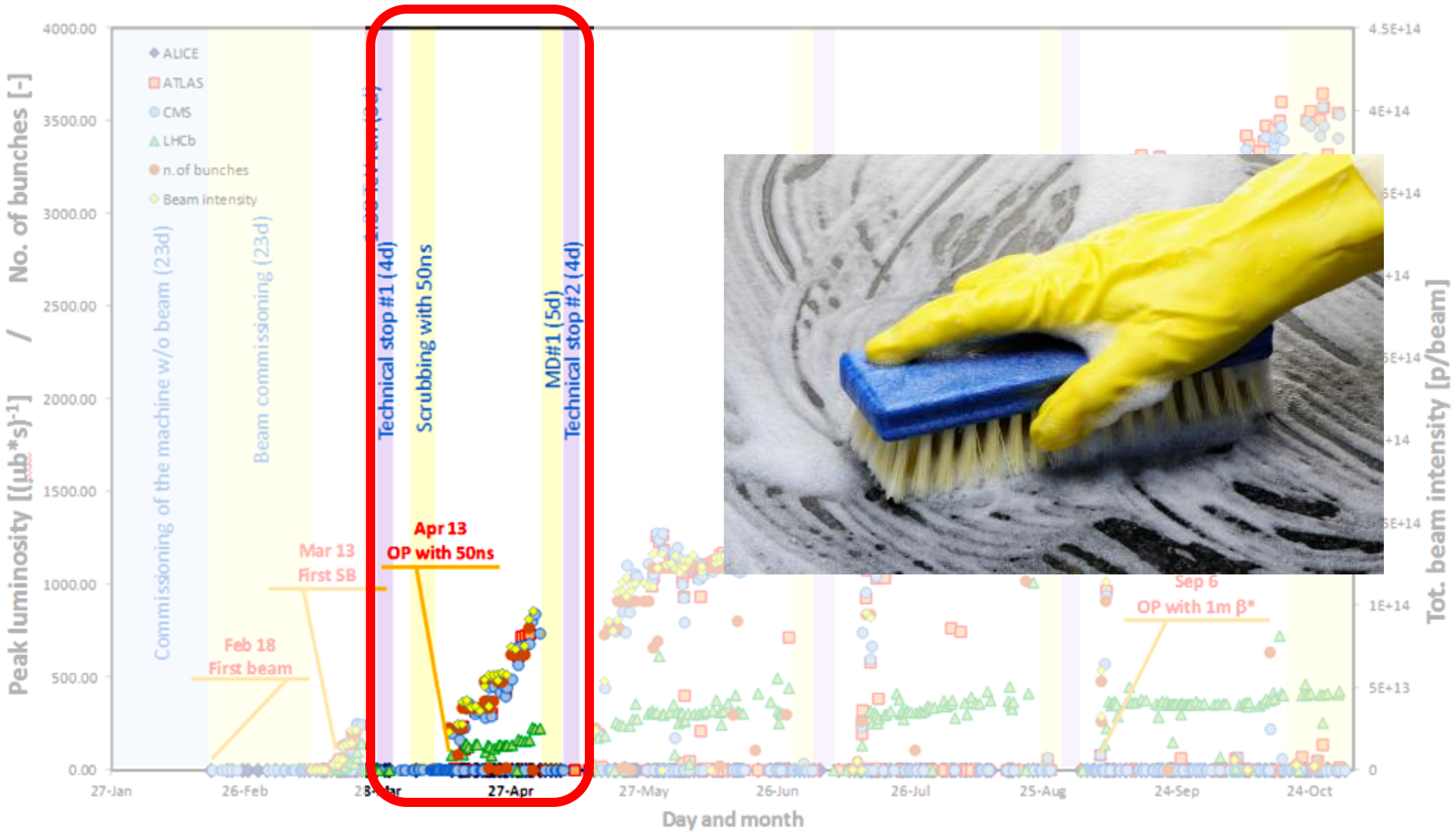


SPECIAL RUN: PHYSICS AT 1.38 TeV



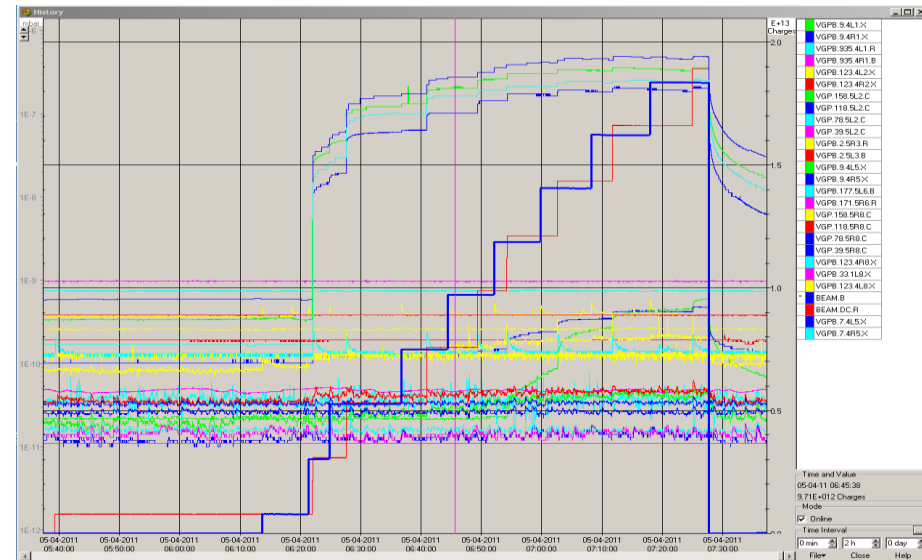
- Special run:
 - Run to 1.38 TeV - 72h between setup and STABLE BEAMS with 80b (4 fills)



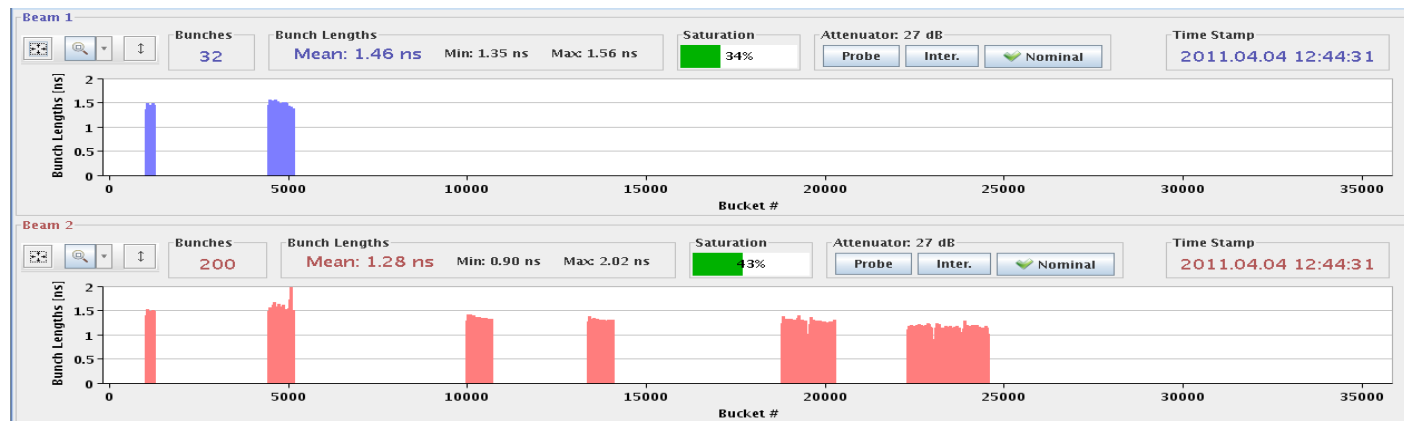


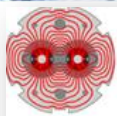


- Abort gap cleaning and injection gap cleaning setup
- Machine protection tests:
 - Beam dump validation @450 GeV
 - Ramp
 - Collimator alignment+loss maps @ inj
 - Ramp/squeeze/collision (2 on 2)
 - chroma measurement and feed-forward
 - Collimator setup @ 450 GeV and 3.5 TeV
- Start of scrubbing run:
 - Apr 4, starting the setup of the 75ns beams
 - Injection of up to 4 trains of 24b



Vacuum activity in IP5 with 200 75ns-spaced bunches injected





Summary of week 14

Scrubbing run

J. Uythoven, J. Wenninger,
G. Arduini



4/11/2011

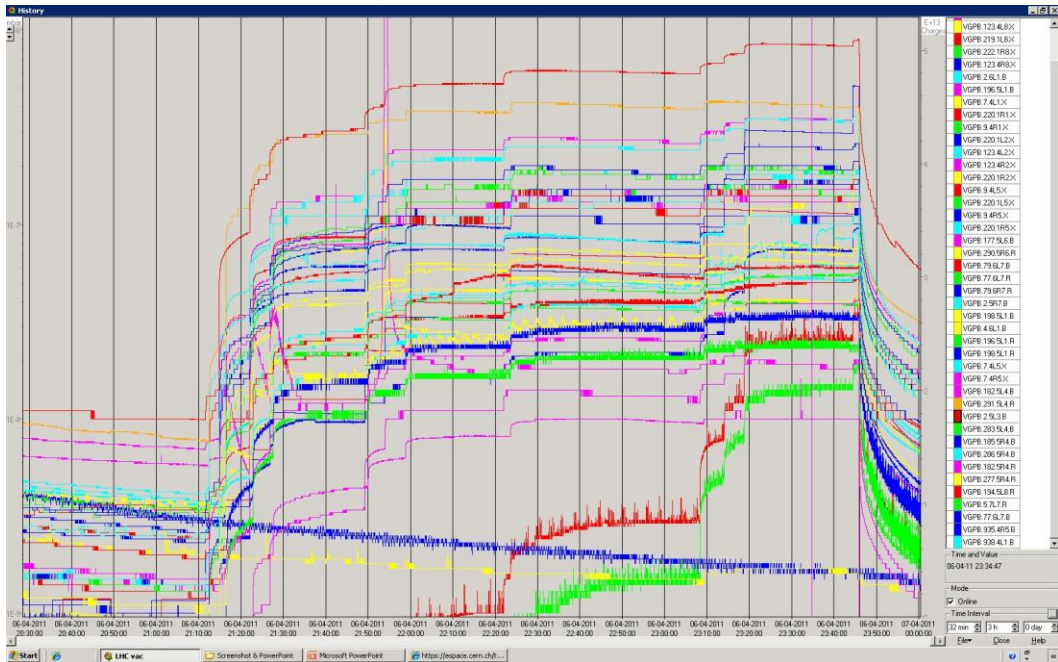


LHC 8:30 meeting

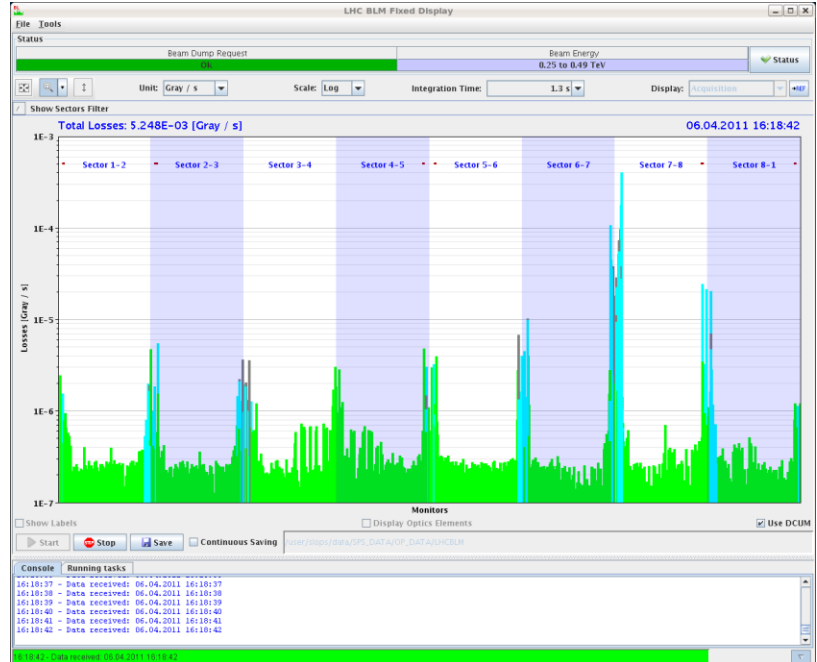




- Chosen strategy:
 - Progressive increase in the number of injected bunches
 - Inject up to vacuum threshold
 - Eventually increase the threshold when/where possible
 - Change intensity and filling scheme (reduce train spacing) to improve the scrubbing efficiency
 - Chroma and octupoles at full range
 - Anti-ecloud solenoids test



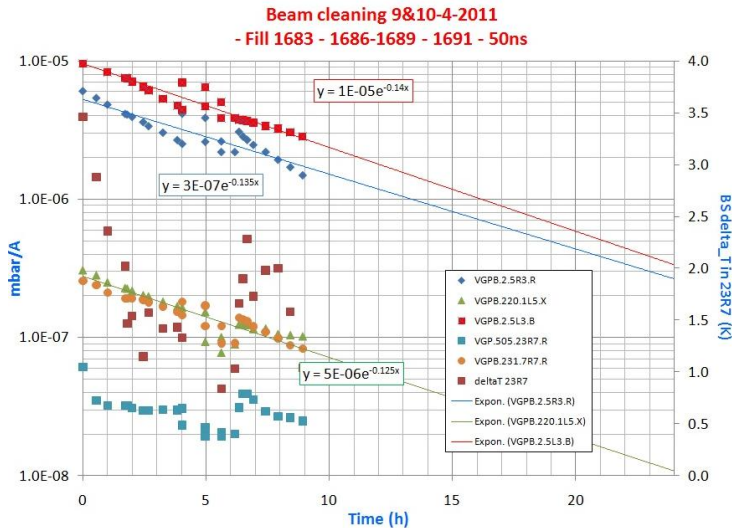
Vacuum behavior with 408 bunches injected



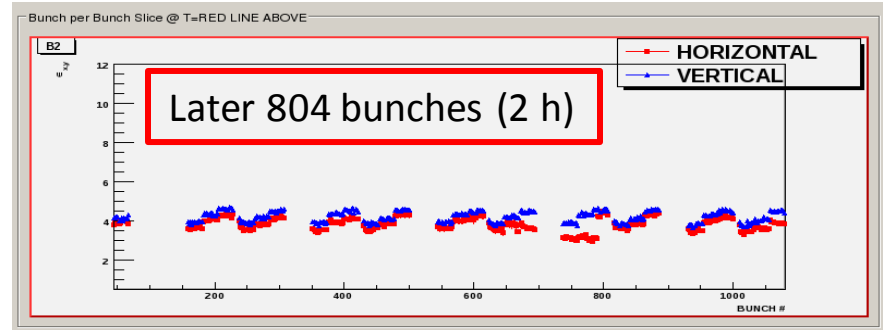
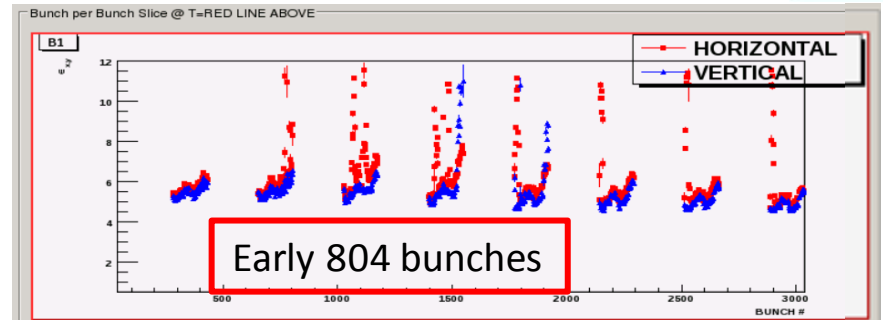
Losses with 300 bunches injected



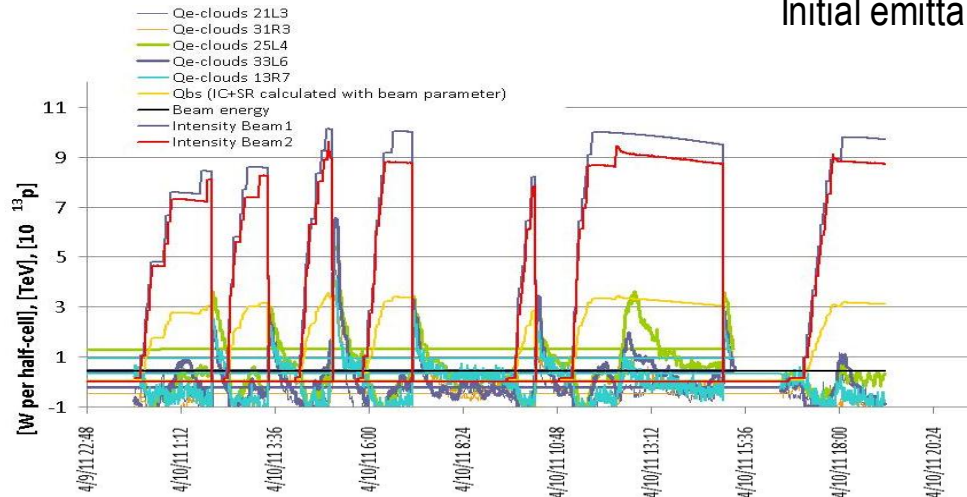
OTHER OBSERVABLES WITH THE 50 NS



Vacuum improvements - V. Baglin



Initial emittance blowup and calming down - F. Roncarolo



Heat loads on beam-screen
W. Venturini

Up to 70
mW/m/aperture
due to e-cloud

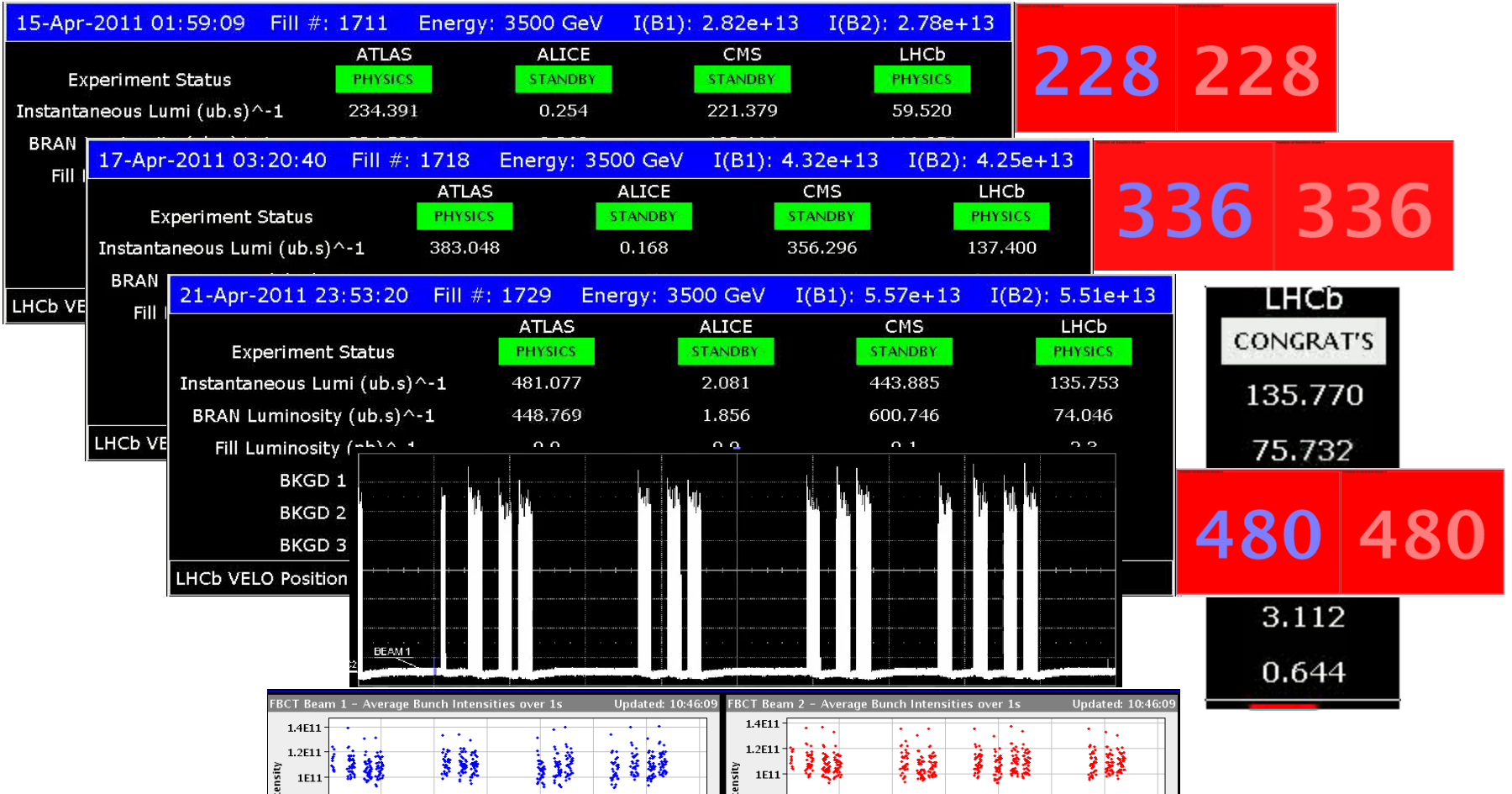
See Giuseppe's in ses.7



LHC LUMINOSITY WORLD RECORD (THE FIRST ONE OF A LONG SERIES...)

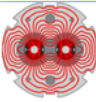


- Following the successful scrubbing period, the use of 50ns-spaced bunches became operational, after the tuning beam life-time, mainly by octupoles and transverse feedback (to cure CBI).
- On Apr 21 at 23:55, the LHC attained the new world record in peak luminosity in a hadron collider.



But with the increase in luminosity, we started speaking as well of SEE...

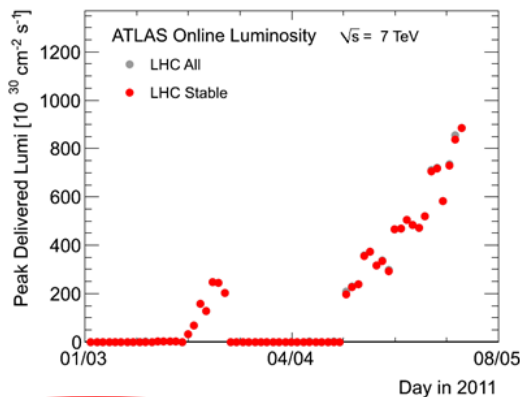
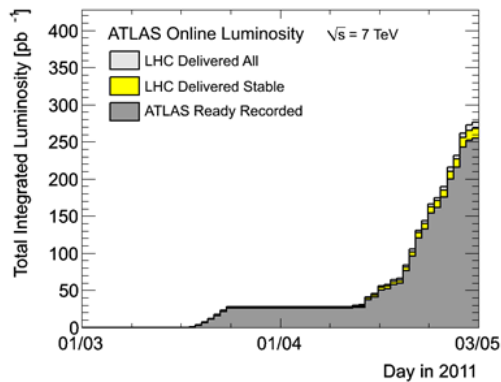




Conclusions

Peak Stable Luminosity Delivered	8.84×10^{32}
Maximum Luminosity Delivered in one fill	29.73 pb^{-1}
Maximum Luminosity Delivered in one day	28.87 pb^{-1}
Maximum Luminosity Delivered in 7 days	129.52 pb^{-1}

on the back of excellent availability, great machine performance



Number of issues – SEEs being probably the one with the potential to hit availability...

30/04/2011

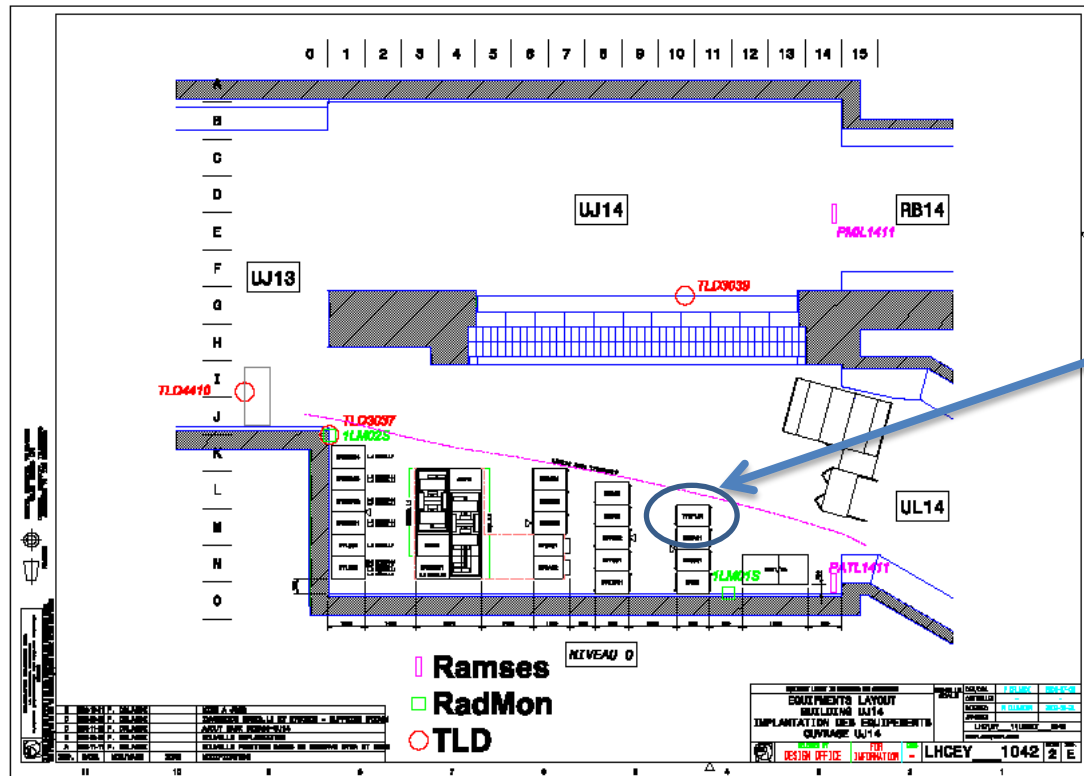
LHC 8:30 meeting



AN EXAMPLE FOR ALL: SEE ON COLLIMATOR CONTROL UJ14



- 2 events on the 27th April and 1st May
 - PRS (monitors the position sensors) rebooted during SB with 768 bunches.
 - Interlock, beam dump
 - Clear signature of SEU
 - Radiation levels in UJ14 last week as high as from start of LHC to week before
 - A few 10^6 HEH (> 20 MeV)

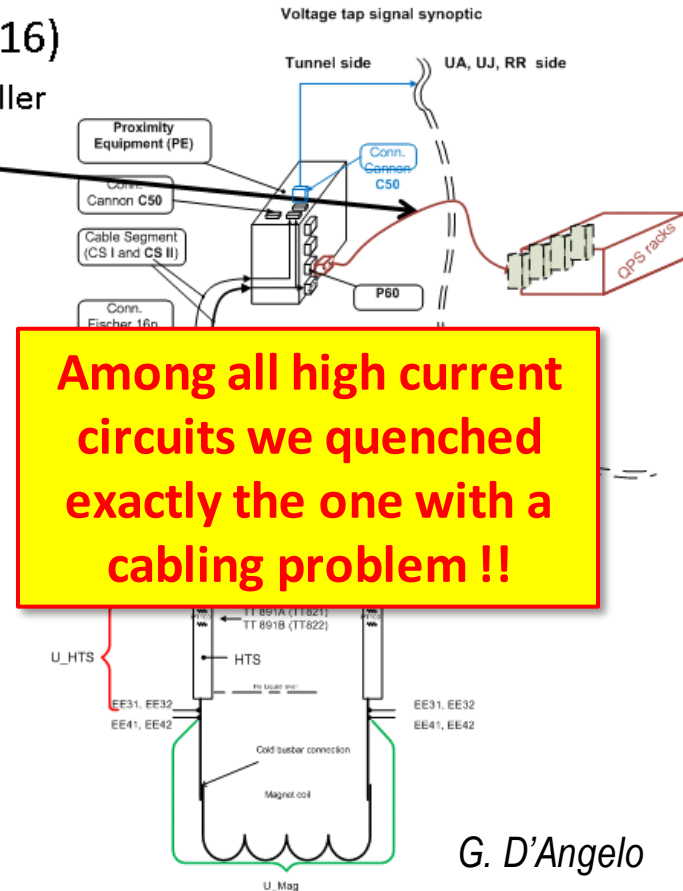


- Faulty electronics board corrupted the temperature feedback loop, which closed the cooling valves of the current lead

What was swapped...?

- What was found swapped in RB.A45, Lead#2 on DFBAI (L5)?
EE22 (pin 15) and EE42 (pin16)
of cable between PE and QPS controller

- The circuit was powered and a quench originated in the HTS
- Due to a tap swap, the HTS protection was missing
- The “redundant” protection triggered
- Powering was stopped for a whole day (TE/MPE)**
- A verification of all U-HTS and U-RES on all Mains, and IPQs, IPDs, ITs using *ad-hoc* powering cycles
- Green light for powering from TE/MPE**



G. D'Angelo



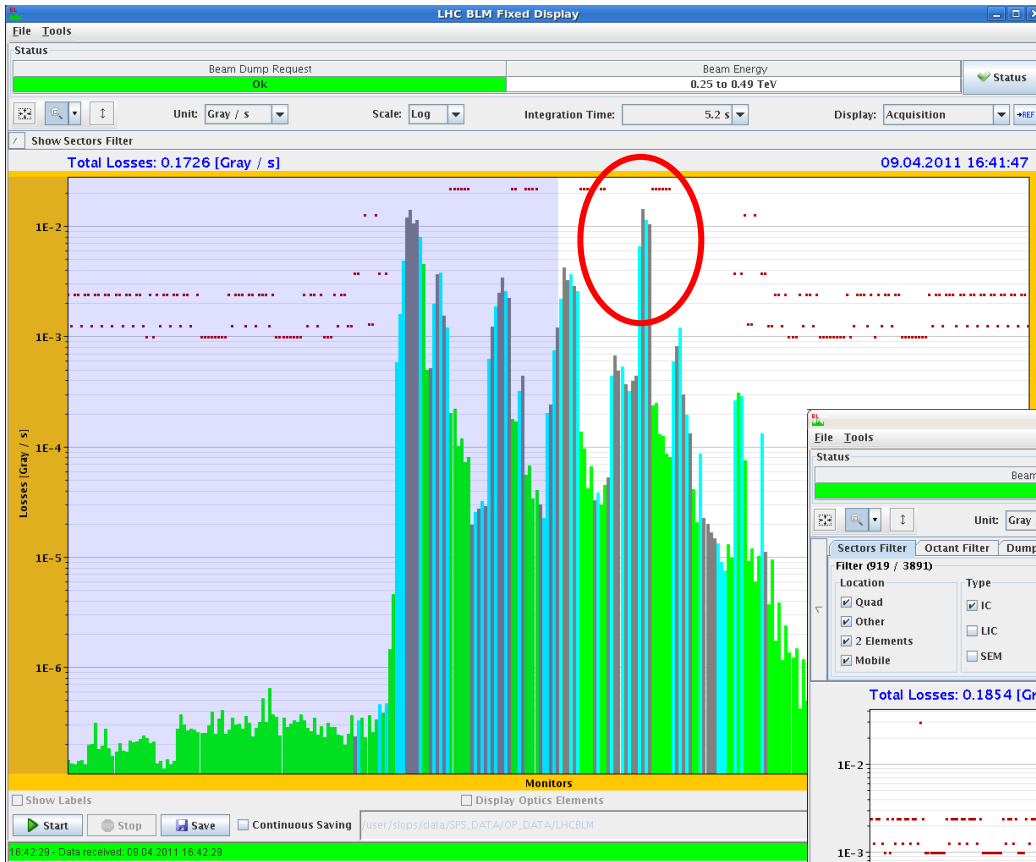
- Traced to a filling pattern dependent shift; fixed with calibration with distinct references (probe, indiv, train)
 - The conclusion was that if the orbit is calibrated in a mode that is consistent with the bunch filling (single bunch, 50 ns, etc) the orbits measured with the different filling scheme agree within ~60 microns rms, and the shift of the mean values are at the level of 10-20 microns maximum



- Affects mostly first bunch

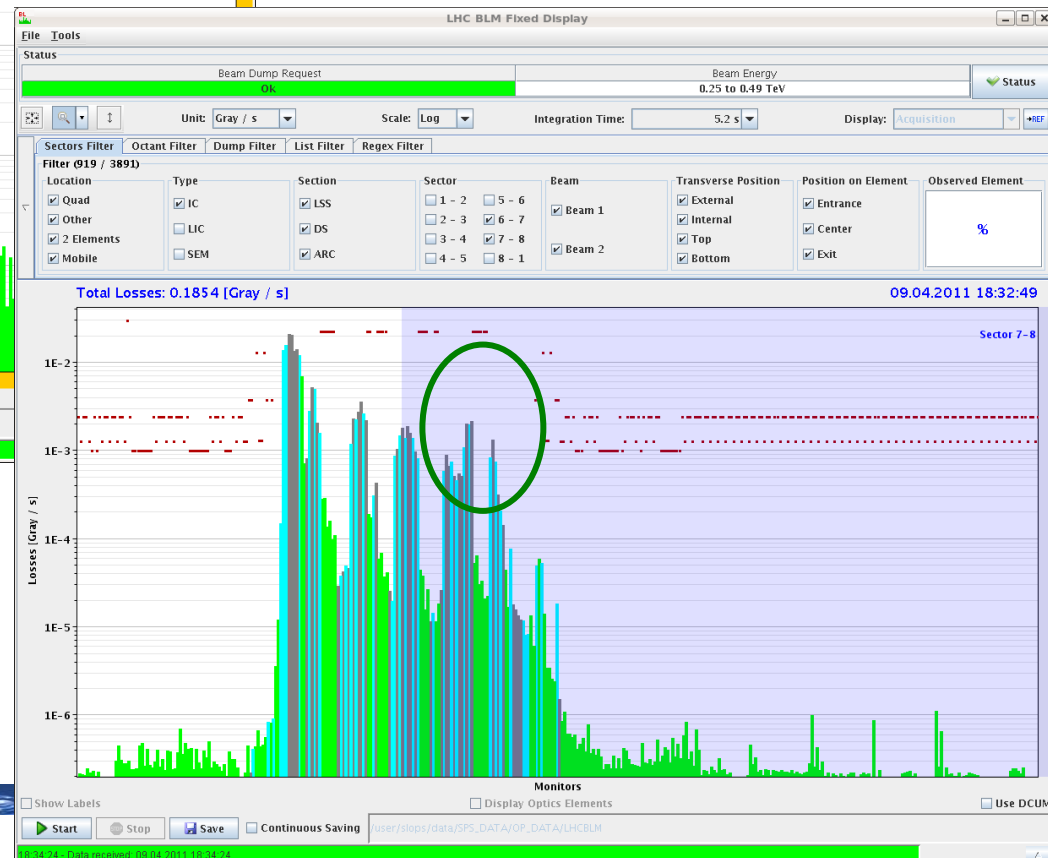


HIERARCHY VIOLATION IN B1H @ 450GeV



Suspicion was that moving Q_V first leads to vertical beam blowup that could change conditions for Q_H map and lead to issues in skew plane uncorrelated to orbit

Tune swap, before loss maps, since





RBA: lhcop

Acquisition

Concentrator Acquisition

Settings

Algorithm

Optimized Algorithm

Settings

Threshold for BLMs

Use running sum:

Threshold for ratio of RS2/1

Threshold for ratio of RS3/2

Threshold for ratio of RS4/3

Get
Set

Action

autosave

Found UFOs

UFO BLM	Losses RS05 [Gy/s]	Time (local)	Losses RS01 [Gy/s]	Losses RS04 [Gy/s]	L	L	L	L	L	L	L
BLMQI.25L8.B1E10_MQ	1.03E-4	2011-04-13 14:06:...	9.05E-4	3.39E-4							
BLMQI.13R3.B1I10_MQ	3.25E-5	2011-04-13 14:06:...	3.62E-4	1.19E-4							
BLMQI.27L8.B2I10_MQ	6.41E-4	2011-04-13 14:06:...	2.53E-3	1.49E-3							
BLMQI.13R2.B2E10_MQ	3.82E-4	2011-04-13 14:06:...	2.44E-3	1.17E-3							
BLMQI.18L5.B1I10_MQ	7.49E-5	2011-04-13 14:08:...	9.05E-4	2.72E-4							
BLMQI.26L1.B2E30_MQ	1.73E-4	2011-04-13 14:11:...	1.18E-3	6.05E-4							
BLMEI.05R8.B2E20_MKI.D5R8.B2	8.56E-4	2011-04-13 14:11:...	3.08E-3	2.13E-3							
BLMQI.19R3.B1I10_MQ	1.48E-4	2011-04-13 14:11:...	3.17E-3	5.94E-4							
BLMQI.07L2.B1E10_MQM	2.12E-4	2011-04-13 14:12:...	6.34E-4	3.73E-4							
BLMQI.18L6.B2I10_MQ	2.18E-4	2011-04-13 14:13:...	1.36E-3	6.56E-4							
BLMQI.19R3.B1I10_MQ	2.77E-4	2011-04-13 14:13:...	1.27E-3	6.56E-4							
BLMQI.07L1.B1I10_MQM	6.93E-5	2011-04-13 14:14:...	1.09E-3	2.72E-4							
BLMQI.29L6.B1E10_MQ	5.15E-4	2011-04-13 14:15:...	7.51E-3	1.97E-3							
BLMQI.16L3.B2E10_MQ	6.66E-4	2011-04-13 14:18:...	4.07E-3	1.86E-3							
BLMQI.10R5.B2I10_MQML	4.94E-4	2011-04-13 14:21:...	4.52E-3	1.91E-3							
BLMQI.10R8.B1I10_MQML	7.85E-4	2011-04-13 14:22:...	3.98E-3	2.63E-3							
BLMQI.28R2.B1I10_MQ	9.33E-5	2011-04-13 14:23:...	5.43E-4	3.05E-4							
BLMQI.25R8.B2E10_MQ	4.41E-4	2011-04-13 14:25:...	3.08E-3	1.51E-3							
BLMQI.26L3.B1I10_MQ	8.91E-5	2011-04-13 14:26:...	5.43E-4	2.94E-4							
BLMQI.19R2.B2E10_MQ	2.83E-4	2011-04-13 14:27:...	1.09E-3	6.22E-4							
BLMQI.09L7.B1E10_MQ	7.58E-4	2011-04-13 14:29:...	3.53E-3	1.67E-3							
BLMQI.26L1.B1I10_MQ	9.05E-5	2011-04-13 14:29:...	6.34E-4	3.00E-4							
BLMEI.05R8.B2E20_MKI.D5R8.B2	9.05E-5	2011-04-13 14:29:...	1.18E-3	3.11E-4							
BLMQI.31R3.B1I10_MQ	5.24E-3	2011-04-13 14:29:...	1.23E-2	7.46E-3							
BLMQI.19R3.B1I10_MQ	2.25E-4	2011-04-13 14:30:...	1.90E-3	7.81E-4							
BLMQI.14R2.B1I10_MQ	8.06E-4	2011-04-13 14:30:...	8.78E-3	3.17E-3							
BLMQI.14L4.B2E30_MQ	5.37E-5	2011-04-13 14:31:...	3.62E-4	1.30E-4							
BLMQI.14R7.B1E10_MQ	5.12E-4	2011-04-13 14:36:...	3.26E-3	1.41E-3							
BLMQI.25R8.B2E10_MQ	1.60E-4	2011-04-13 14:39:...	1.18E-3	4.92E-4							
BLMQI.25R8.B2E10_MQ	1.75E-4	2011-04-13 14:41:...	9.96E-4	5.32E-4							
BLMQI.12L4.B2E10_MQ	6.55E-4	2011-04-13 14:43:...	2.26E-3	1.24E-3							
BLMQI.28R7.B2I10_MQ	4.51E-4	2011-04-13 14:44:...	2.99E-3	1.43E-3							
BLMQI.08L3.B1I10_MQ	1.13E-3	2011-04-13 14:46:...	1.72E-2	4.33E-3							
BLMQI.25R7.B1E10_MQ	1.20E-4	2011-04-13 14:47:...	1.18E-3	4.52E-4							
BLMQI.31R5.B2I10_MQ	2.67E-4	2011-04-13 14:47:...	1.90E-3	9.16E-4							
BLMQI.18R8.B1I10_MQ	3.96E-4	2011-04-13 14:48:...	3.17E-3	1.44E-3							
BLMQI.24R8.B2E10_MQ	3.01E-4	2011-04-13 14:50:...	2.26E-3	1.05E-3							
BLMQI.21L6.B2I10_MQ	2.53E-4	2011-04-13 14:51:...	2.72E-3	9.79E-4							
BLMQI.14R2.B1I10_MQ	5.19E-4	2011-04-13 14:51:...	6.06E-3	2.03E-3							

Remove
Remove all
Show data
save
load

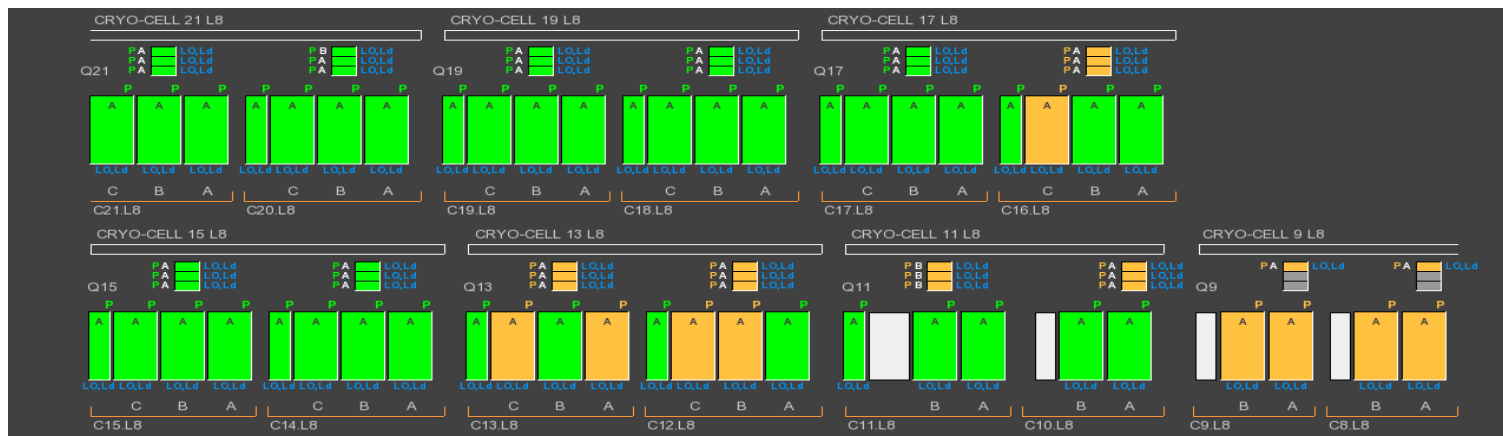
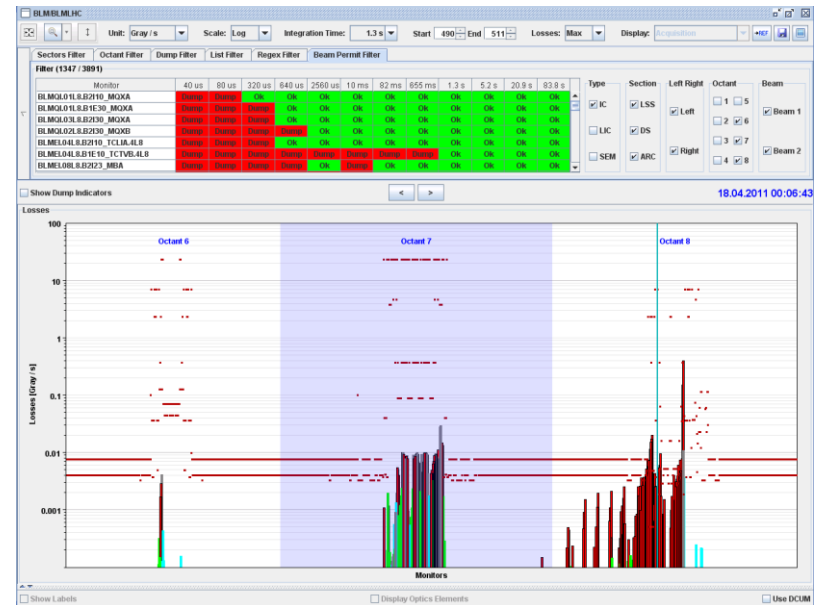
14:47:47 - New RBA Token was set to CMW: RBA Token[serial=0xd7f7b4dd;authTime=2011-04-13@14:34:48;endTime=2011-04-13@22:33:48;application=AppPrincipal[name=UFO Buster, critical=false, timeout=1];locatio...

See Tobias' in ses.5





- Real breakdown in MKI8.D, between two 36b trains in a 72b batch
- 36b overkicked and grazed lower jaw of TDI/TCLI
 - About half of this intensity was transmitted into LHC (2e12)
- Worst case scenario for injection protection
- Quench heaters fired on 9 dipoles and 2 quads, mostly like real quenches.
- 1-2 doubtful cases



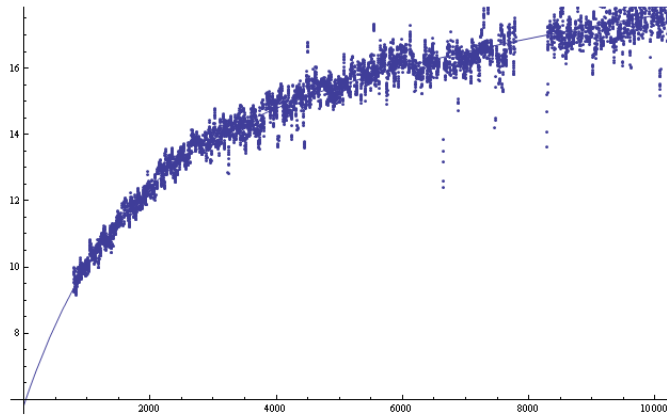


- Apr 15: test of the luminosity leveling
- The solution for LHCb and ALICE and the possibility for the others

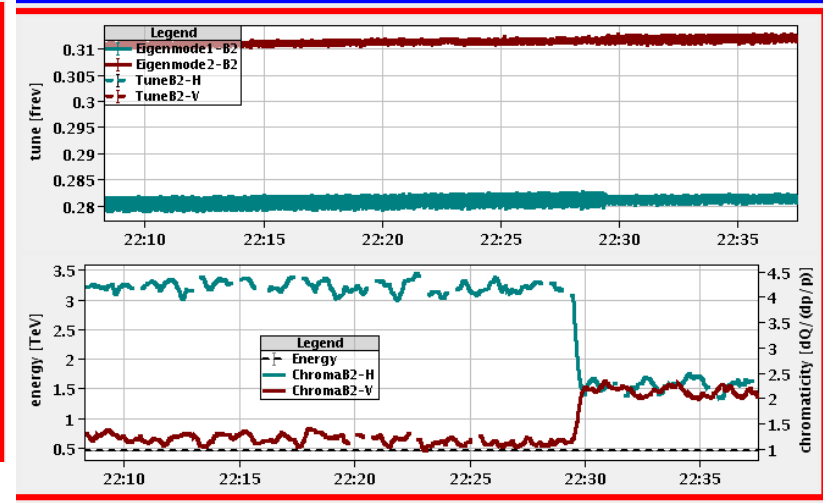
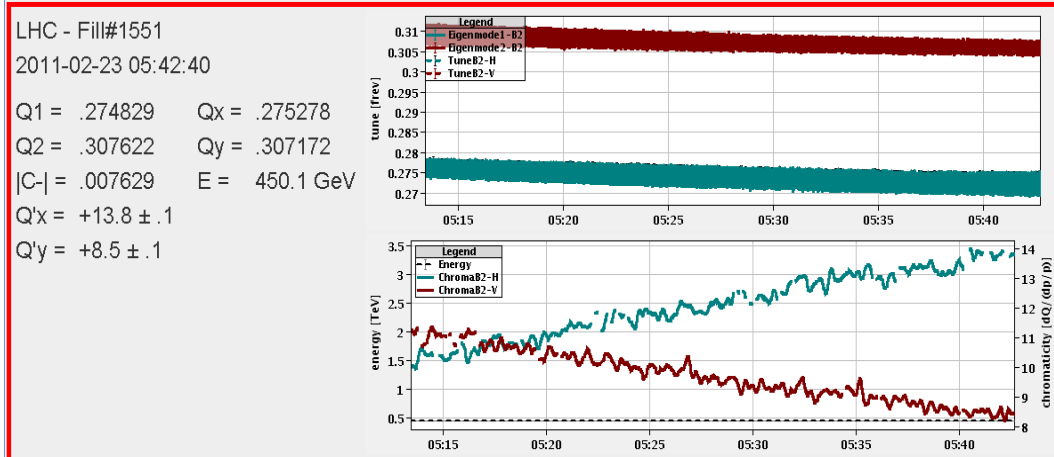
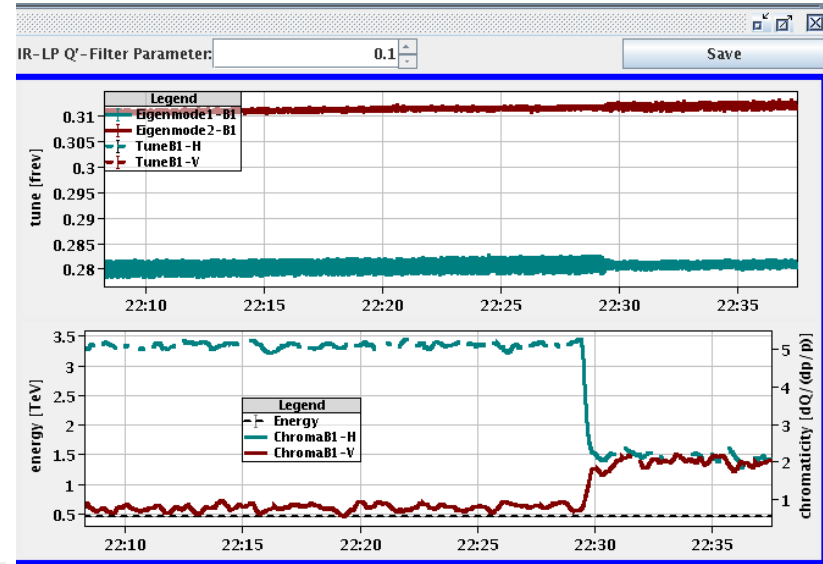




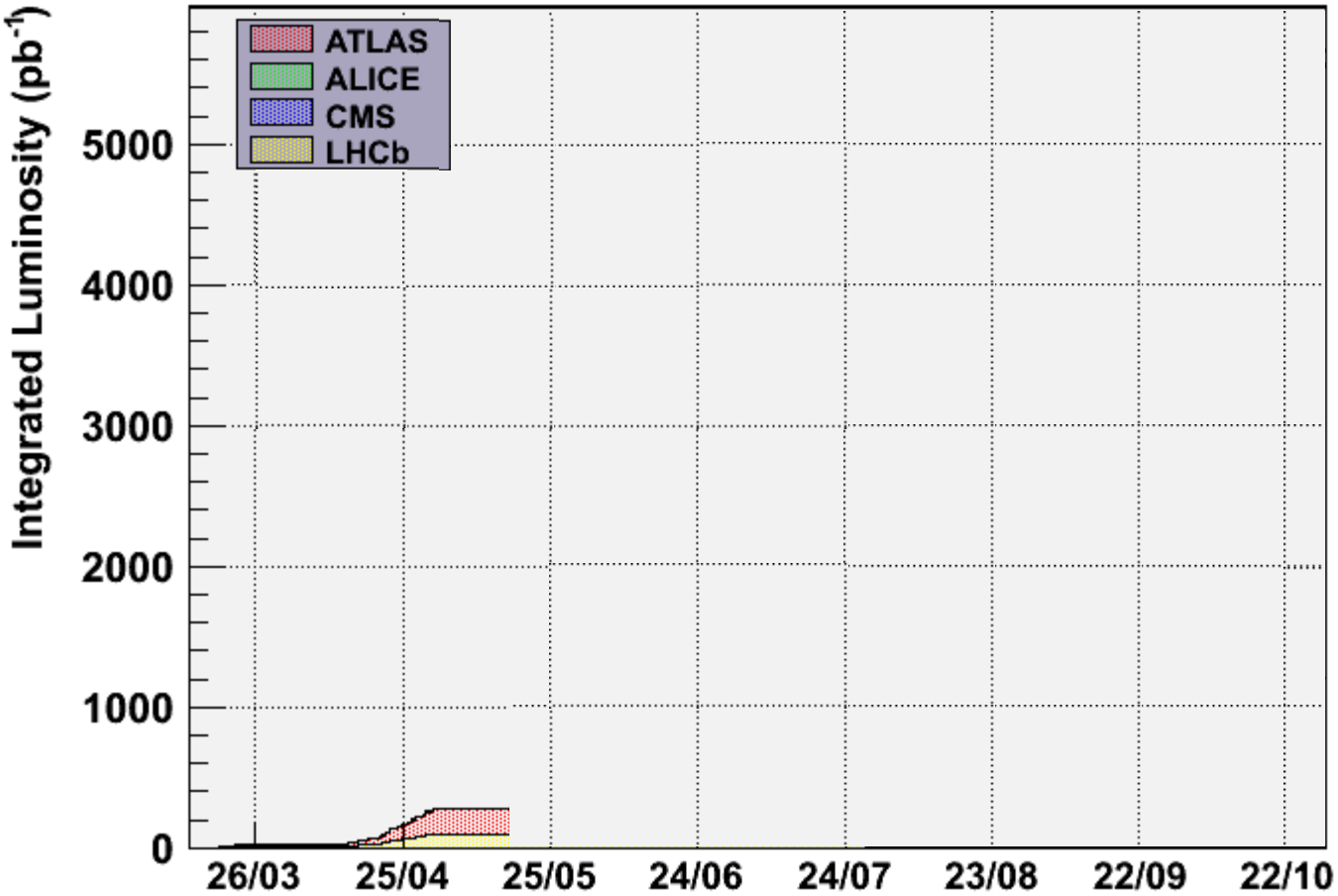
- Apr 29: dynamic b3 correction



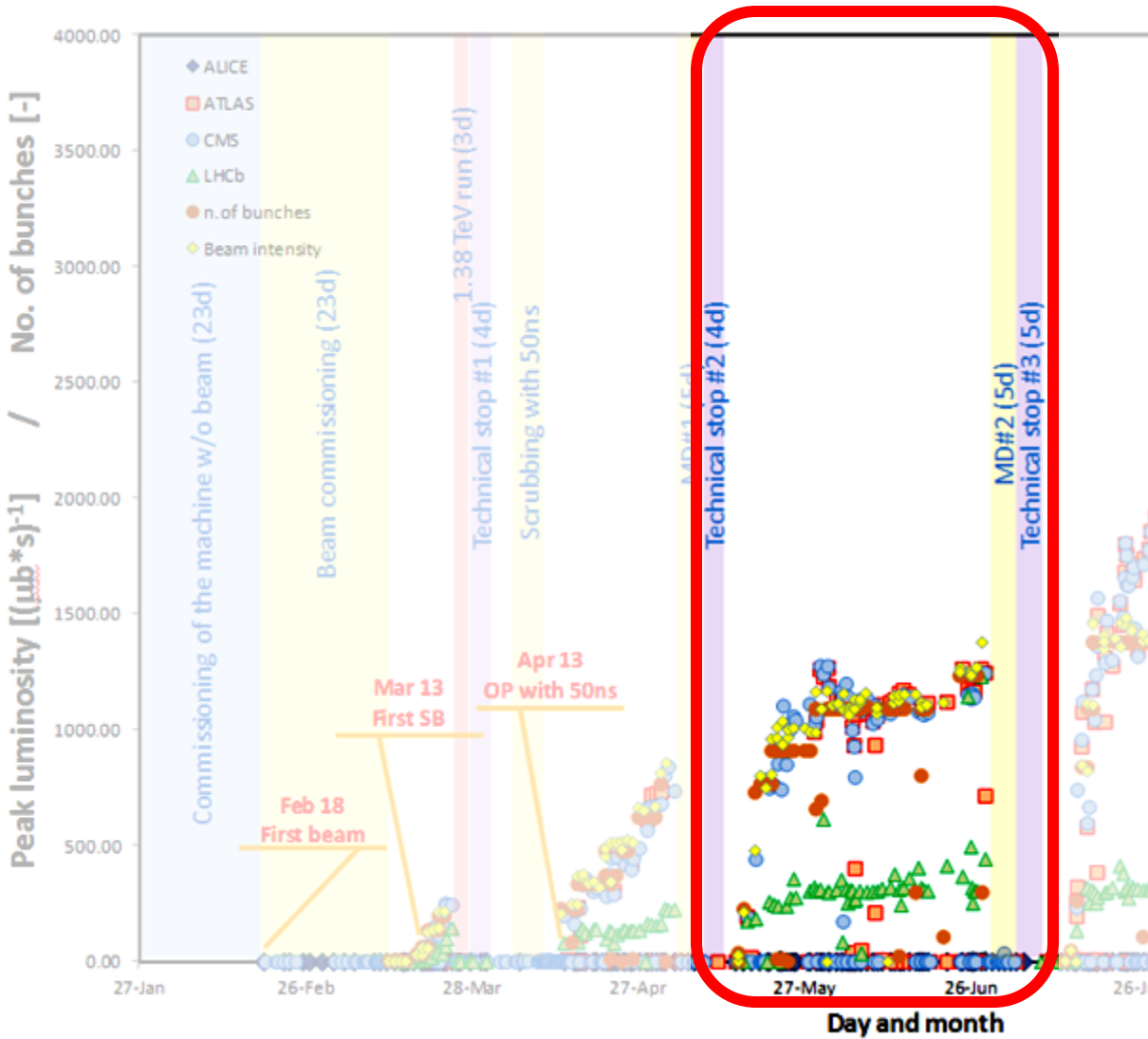
Chromaticity swing at injection



2011 Luminosity Production



CONSOLIDATION FOR LUMINOSITY INCREASE



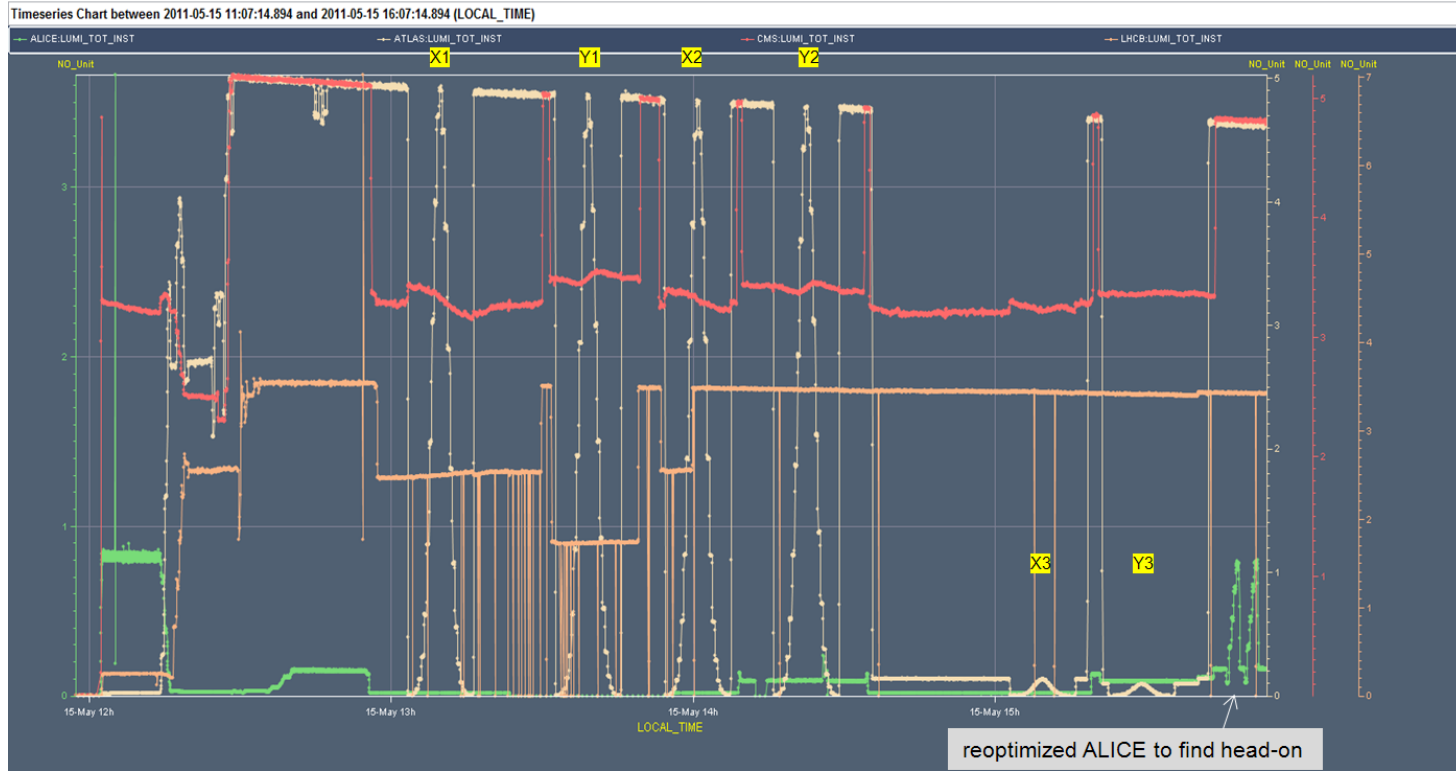


- Ramp&squeeze&collision with pilots - MP dump test; next loss maps

ATLAS scans

X, Y, X, Y, X with Y separation*, Y with X separation* (*Chose 0.16mm)

All two-beam symmetric, +/-6 sigma, 25 steps, 20s/step



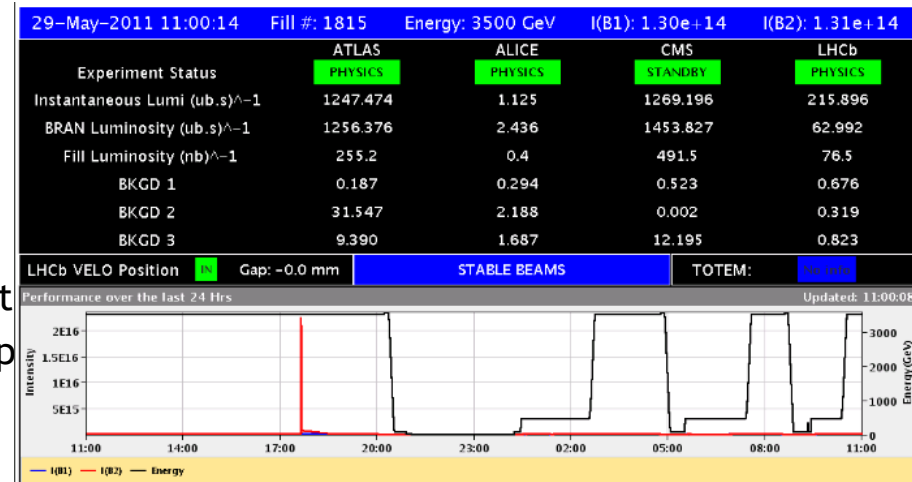
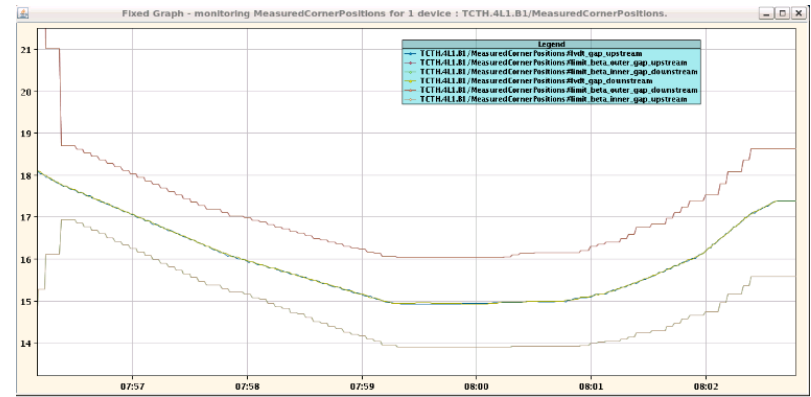
During the ATLAS scans: IP5/2/8 separated by 0.05/0.128/0.088 mm in the scanned plane (but IP8 only for first X/Y pair, then moved head-on in middle of 2nd X scan).

Error: ALICE should have been head-on but wasn't (not optimized in X), hence the separation in X was onto another one





- Ramp up in bunch number to before-TS state:
 - 1x1
 - 228x228
 - 480x480
- May 17:
 - Preparation for roman pot alignment (ALPHA and TOTEM)
 - Beam dumped by roman pot movement
- May 20:
 - 768x768 (with BPM@6 interlock check)
- May 21:
 - Vacuum instabilities in the triplet L8 related
 - 912x912
 - More than 10^{14} p/beam in collision
 - Lumi $1.1e33cm^{-2}s^{-1}$
- May 29:
 - 1092x1092 --> $1.25e33 cm^{-2}s^{-1}$
 - Test of dynamic betastar limits for collimat
 - Octupoles now on at injection and in first p

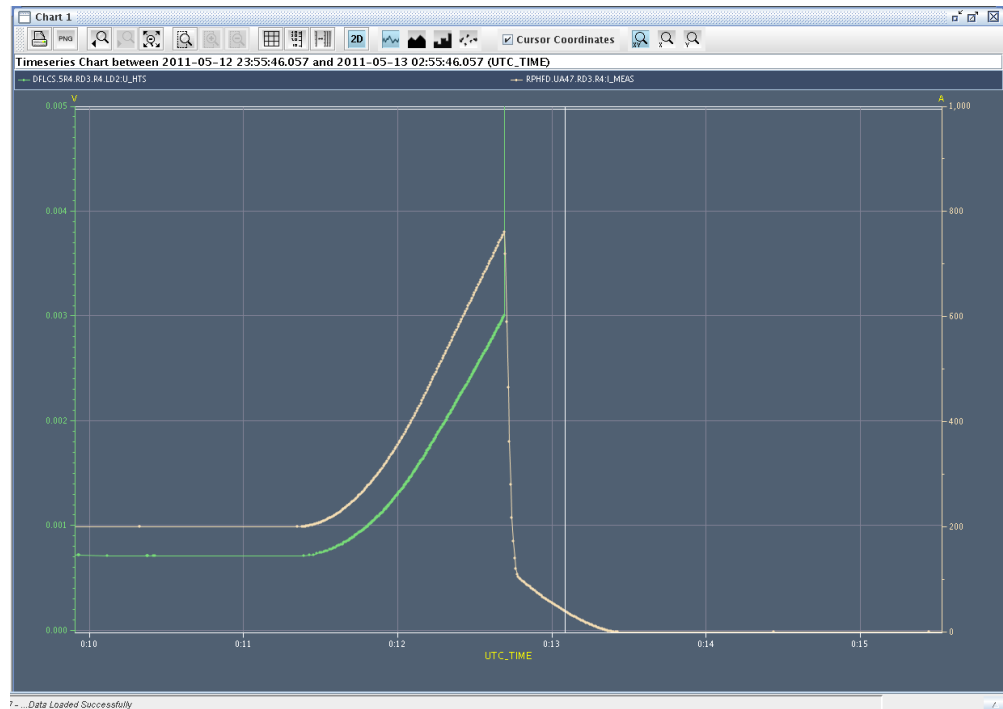
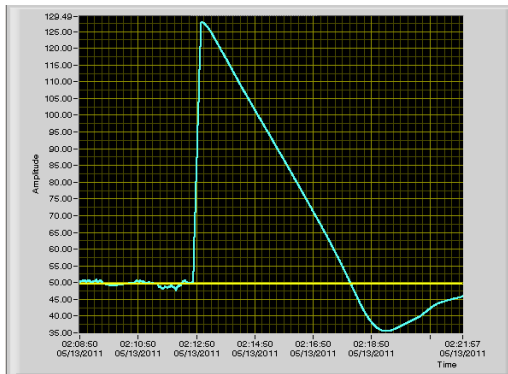


• Again many problems...

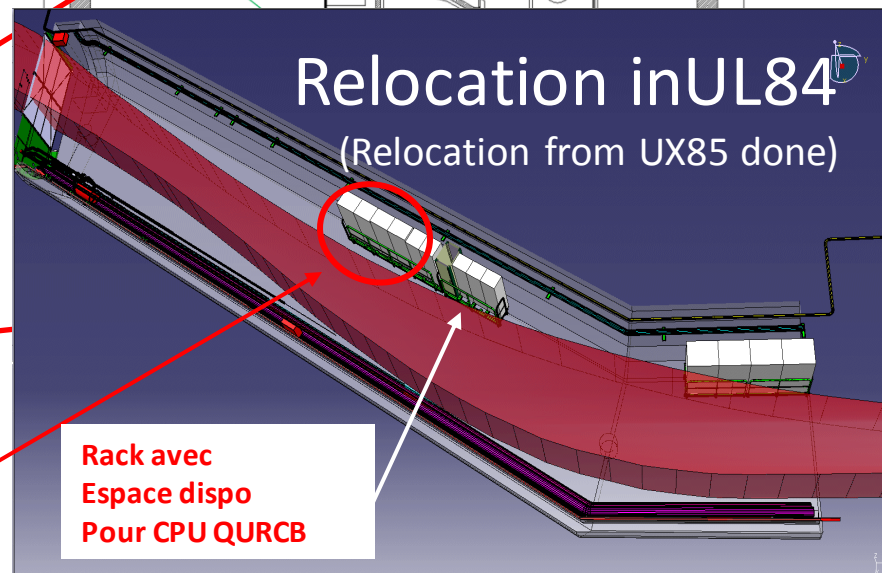
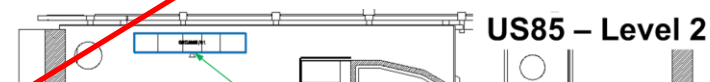
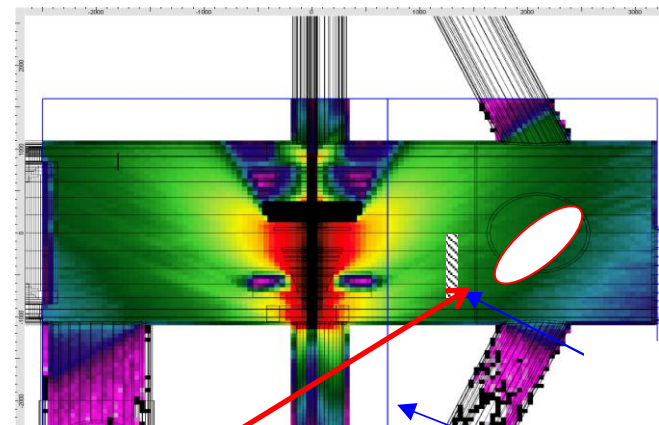
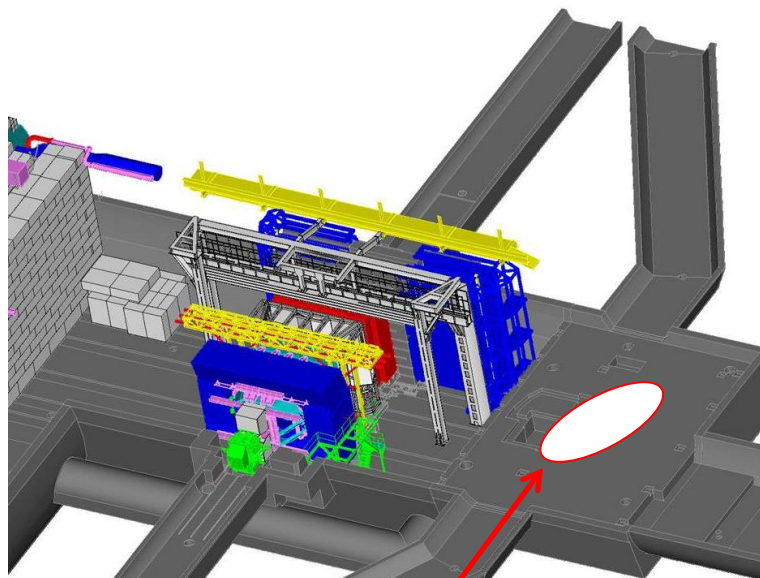




- May 13: quench of current lead on RD3.R4
 - Quench at 763 A (3.5 TeV = 2750 A) triggered from the HTS voltage on LD2 of DFBMK increasing proportionally to the current and reaching 3 mV
 - When the ramp starts, the CV is at 0% and starts to open only when the HTS voltage is already above 2 mV. After the quench, the CV opens to 100%.
 - TT891A gives 50+-2 K up to the quench. After the quench, the temperature shoots up to 127 K.
 - Seems that temperature reading and cryo valve regulation are correct but that there is a problem with the voltage reading



- May 25: SEE on cryogenic PLC



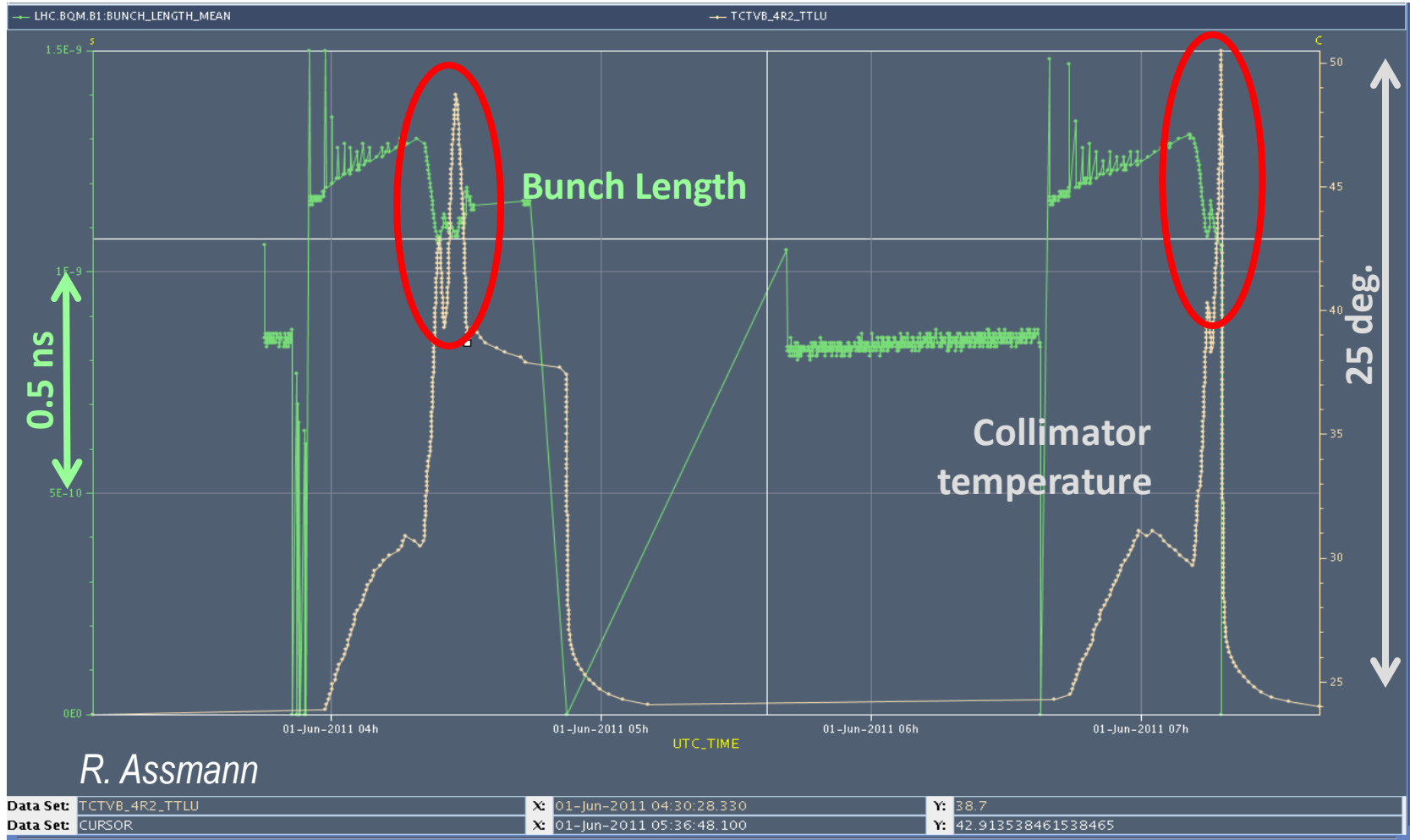
QURCB PLC localization

**Relocation Racks
CB 2011/2012**

S. Claudet



- Collimator Heating by EM fields



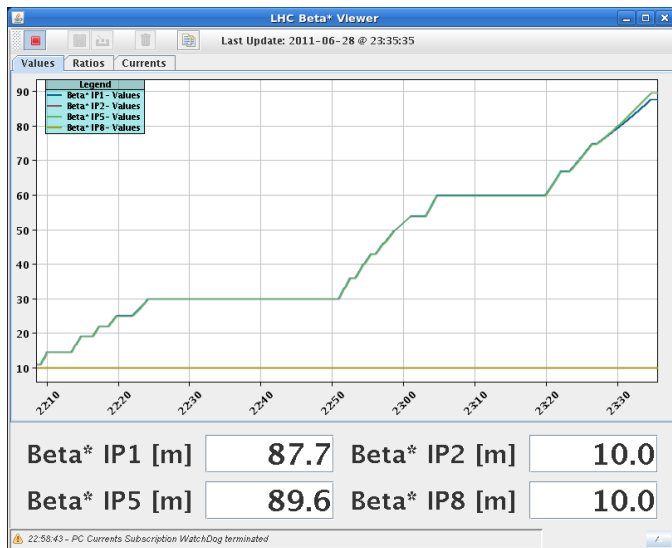
See Benoit's in ses.7



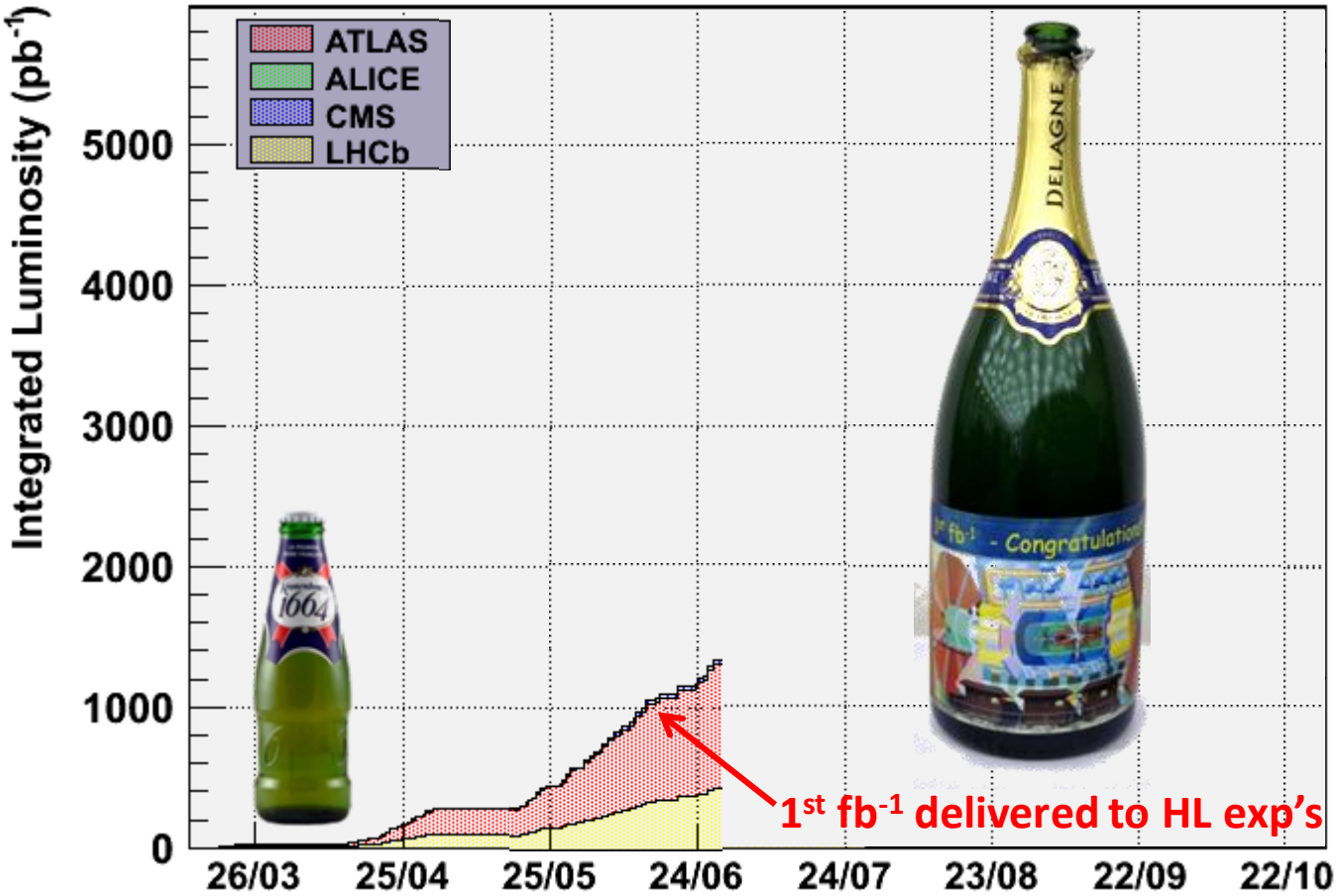
FINALLY...A HAPPY CONCLUSION OF THE PERIOD



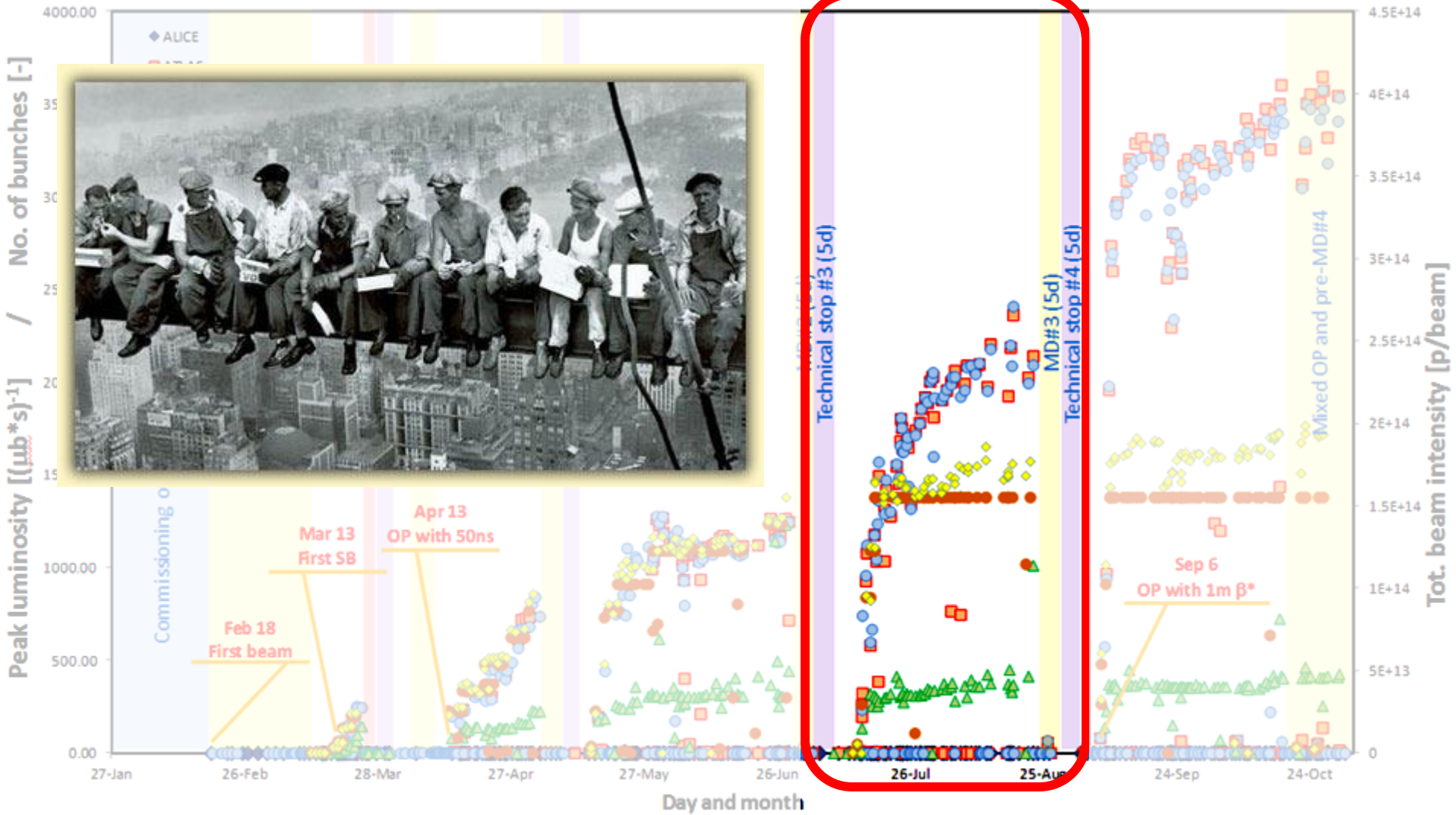
- A lot of faults, obviously time-dominated by cryogenics (two major stops <- >thunderstorm), but many from QPS, UFOs, PCs, glitches, RF, collimators, vacuum (3 events which led to increases thresholds in IR4 from 4e-7 to 2e-6), injectors and many SEE (also a problem on the optical fibers of BIS loop, fixed during the following TS)
- But then, just before moving to MD#2, we got two beautiful fills:
 - 1236b with lumi 1.25e33 cm-2s-1, dumped by OP, producing 60 pb-1 in 20 h
 - The first fill with 1380b, dumped by OP, with 46 pb-1 in ~14h
- Then 90m setting up
 - At 90m, tested in IP1/5 all the knobs for parallel separation and for lumi scans
 - 30 mins data taking for ALFA and TOTEM



2011 Luminosity Production



WORKING AT HEIGHT OR THE 1380B STANDARD OPERATION



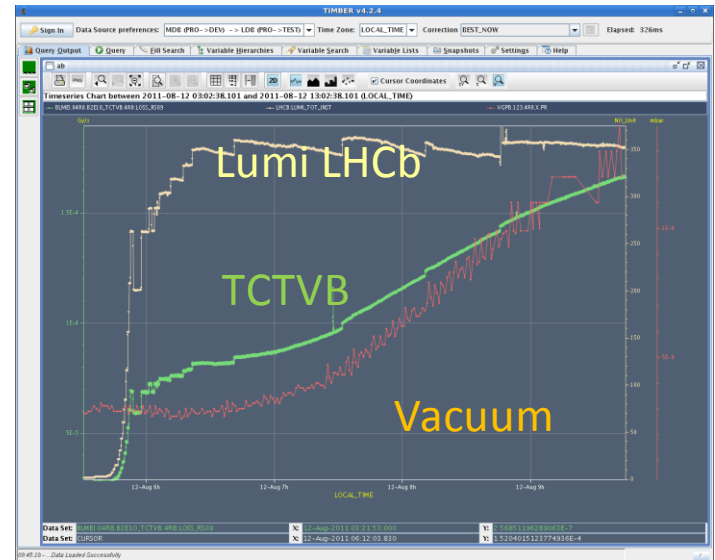
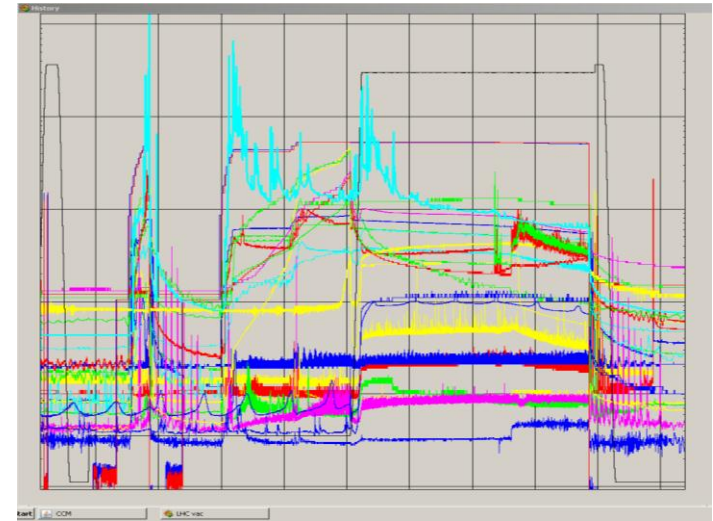


- Verification tests:
 - TCDQ and TCSG relative position --> re-measurement required
 - beam presence flag intensity limit
 - Beam dump (inject and dump mode)
 - asynchronous dump 450 GeV B2 (pilot or 1-2 nominal bunches)
- Pilot + 2 nominal bunches
 - loss maps at injection
 - 1 hour in stable beams
 - loss maps at 3.5 TeV
- 48 bunches per beam
 - new fill pattern for satellite on main collisions in ALICE: pilot over-injected, 250ns SPS gaps
 - MKI pulse length might need increasing
 - keep in stable beams for 3-4 hours (check with experiments)
- Continue with the satellite collision scheme (unless requested otherwise by ALICE):
 - 50ns_264b_249_0_240_36bpi8inj (1 fill)
 - 50ns_840b_807_0_816_108bpi12inj (1 fill) X 2
 - 50ns_1092b+1small_1042_35_1008_108bpi
 - 50ns_1380b_1331_0_1320_144bpi12inj.txt (luminosity production)
- From mini-Chamonix: adiabatically increase the bunch intensity/reduce emittance

“ADIABATICALLY” INCREASING BUNCH INTENSITY



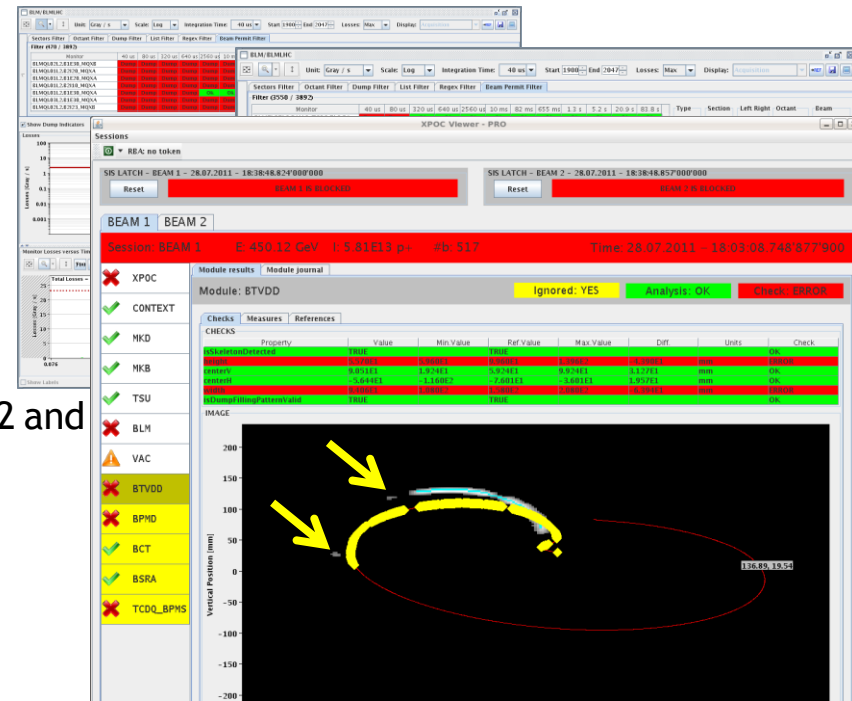
- With $1.3e11$ vacuum kicked off spectacularly
- Bunch intensity gently pushed up to $\sim 1.25e11$
- Getting between 2.2 - 2.5 microns into collisions, later further down to ~ 2 microns
- Switching e-cloud solenoids off for cleaning
- Losses going into collision
 - 1 & 5 - pushing above warning on secondaries in IR7 (long running sum) during optimization
 - LHCb optimization can provoke additional lifetime dip
- Many SEE



Losses on collimators during LHCb optimization



- Jul 28: erratic on the MKI
 - 144b dumped on TDI in IR2
 - Injected beam was not kicked
 - Circulating beam was not hit
 - Heavy losses in IR2, but NO quench
- Jul 28: circulating beam on TDI in IR2
 - Circulating beam was hit and kicked to the TDI
 - Some grazing bunches quenched RD2.R2, RD1.L2 and
 - Important leakage to S23 (but no quench)
 - 200b missing in dump --> on TDI



- First dumps from PIC-PLC:
 - Both beam dumps caused by a stop of a Powering Interlock PLC, located (together with 2 others) in UJ56 / UJ14
 - PLC stoppage lead to loss of communication with remote I/O units in RR57/UJ14 and consequently initiated Fast Aborts in all protected circuits and the beam dump
 - Identical failure signature of 120 x ANYBUS + 36 x XC95144
 - Not sure whether SEU
 - For all 9 PLCs in UJ14/UJ16 extension cables pulled), st

Remote I/O close to clients
120 x ANYBUS + 36 x XC95144



IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8
RR13	UA23	UJ33	UA43	RR53	UA63	RR73	UA83
UJ14	UA27		UA47	UJ56	UA67	RR77	UA87
UJ16							USC55
RR17							RR57

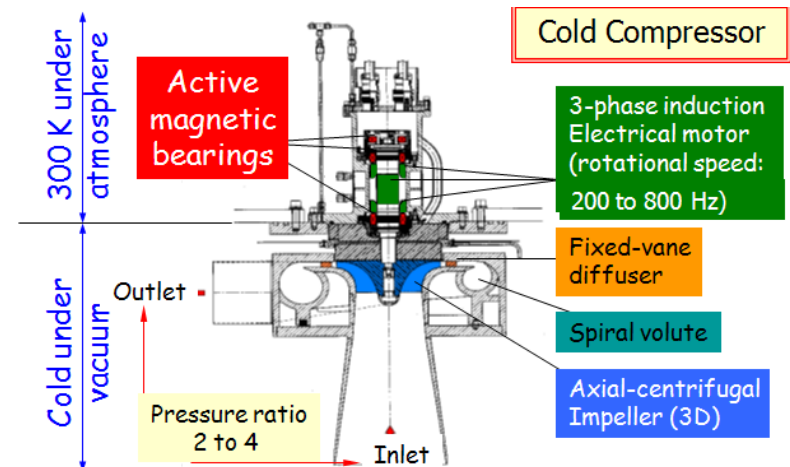
M. Zerlauth

- Bunch intensity pushed up to $\sim 1.3.5e11$
- Average emittance $\sim 2+$ microns
- Peak luminosity $2.2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$

- Aug 11: SPS magnet exchange (dipole in place in cell 520)
 - 16 hours from beam off to beam ready in SPS (we would dream something like that at the LHC...)

- Aug 12: trip of cold compressor in point 8
 - Sudden variation in the measured value of the rotation speed of the turbine on magnetic bearings leading to a fast stop of the cold compressor
 - Restarted, failed again
 - Electronics exchanged

- In the shadow of the timeouts:
 - ‘Dry’ squeeze test first to 1.0 m and then on to 0.55 m
 - Test of Q20 with extraction in TI2





- Aug 12: loss maps @3.5 TeV with roman pots (TOTEM and ALPHA)
- Aug 21: ALFA on beam
Collimators at tight settings
- Aug 23-24: 90 m optics run:
 - Mostly set-up of TOTEM (alignment of vertical roman pots). ALFA alignment not possible due to PXI problem
 - No TOTEM/ALFA data taking due to premature EOF
 - Difficulties encountered in filling scheme with bunches of different intensity due to limitations in the quality of the orbit reading
 - Not efficient setting-up

- Aug 18: MP7 accident, with the damage of a 18 kV power cable during excavation
 - General power cut
 - ATLAS, ALICE and LHCb tripped.
 - Injection kickers tripped.
 - All RF tripped. Undulators tripped.
 - Collimators seem to be in a bad state.
 - Dump kickers faulty.
 - All 8 sectors tripped.
 - All vacuum valves in.
 - Cryo: 4 sectors stopped. 23, 34, 78, 81

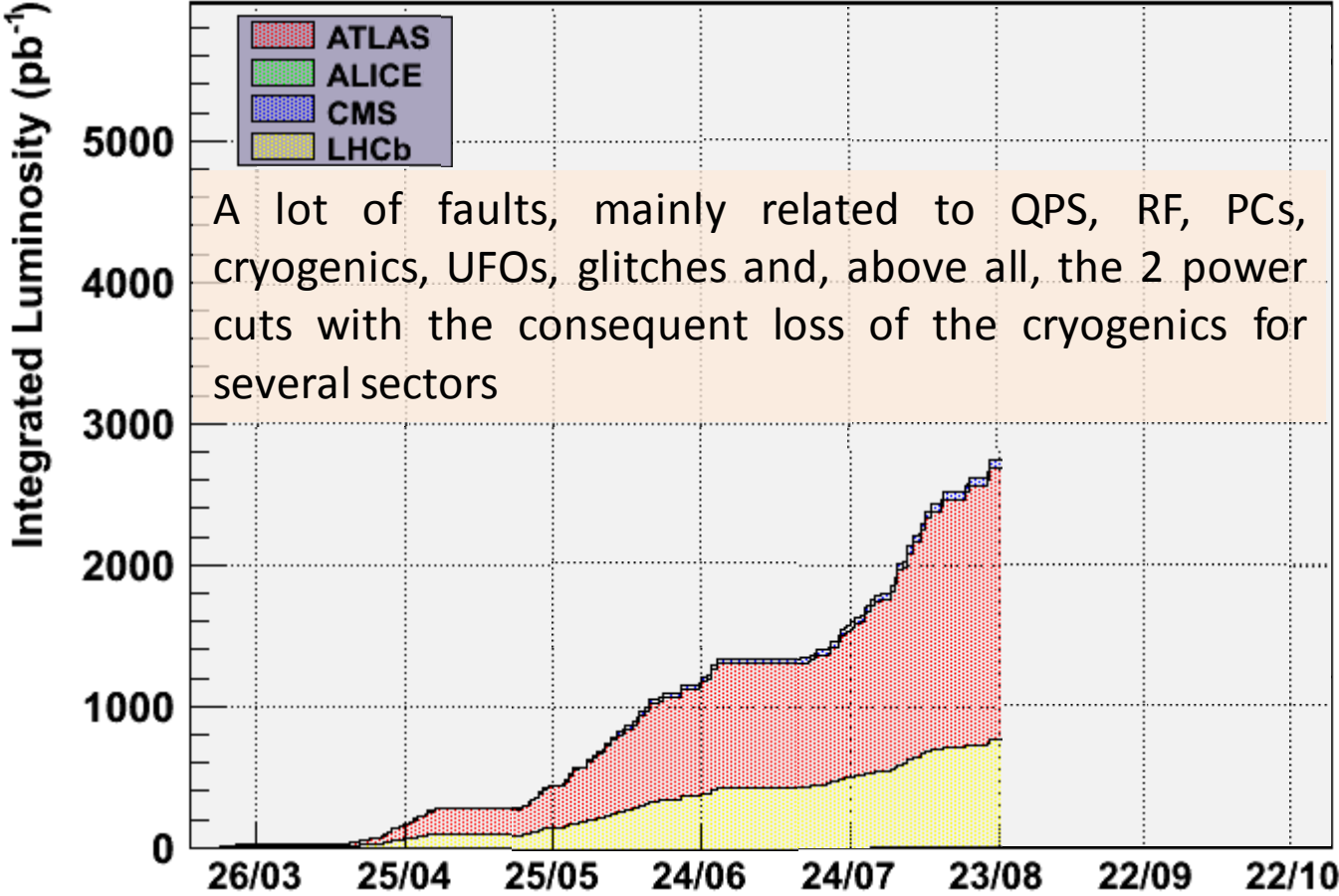


16-08-2011 12:15:41

PROTON PHYSICS: NO BEAM										
S 12	CM ITR1	CS ITR1	CM MSR1	CS MSR1	CM AR12	CS AR12	CM MSL2	CS MSL2	CM ITL2	CS ITL2
S 23	CM ITR2	CS ITR2	CM MSR2	CS MSR2	CM AML3	CS AML3				
S 34	CM AMR3	CS AMR3	CM MSL4	CS MSL4						
S 45	CM MSR4	CS MSR4	CM AR45	CS AR45	CM MSL5	CS MSL5	CM ITL5	CS ITL5		
S 56	CM ITR5	CS ITR5	CM MSR5	CS MSR5	CM AR56	CS AR56	CM MSL6	CS MSL6		
S 67	CM MSR6	CS MSR6	CM AML7	CS AML7						
S 78	CM AMR7	CS AMR7	CM MSL8	CS MSL8	CM ITL8	CS ITL8				
S 81	CM ITR8	CS ITR8	CM MSR8	CS MSR8	CM AR81	CS AR81	CM MSL1	CS MSL1	CM ITL1	CS ITL1
60 A	S12	S23	S34	S45	S56	S67	S78	S81		
RF :	CM 1L4	CS 1L4	CM 2L4	CS 2L4	CM 1R4	CS 1R4	CM 2R4	CS 2R4		

Most critical situation for the circuits and their protection.
Though some heaters fired, the whole protection system worked fine.

2011 Luminosity Production



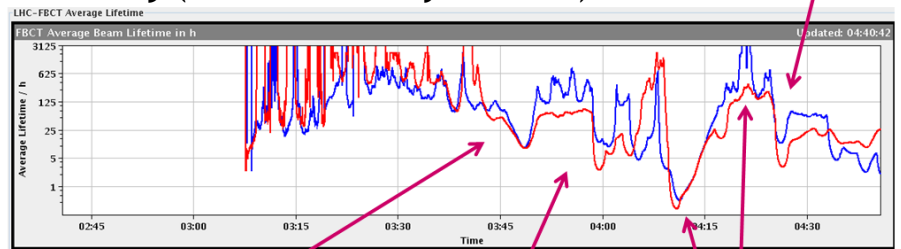
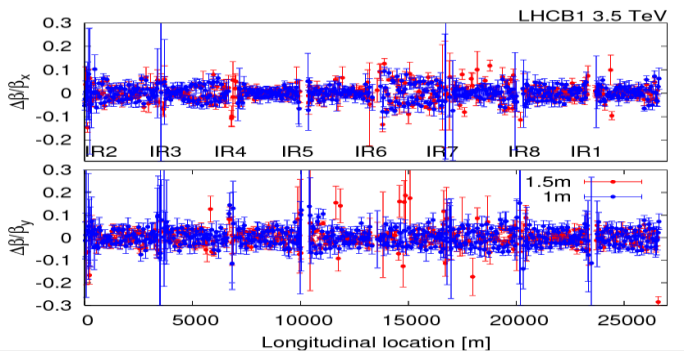




Just before TS, in MD#2

- Collimators to tight settings
- 1m β^* setup
 - Xing angles in IR1/5 from ± 120 to $\pm 100 \mu\text{rad}$
 - Optics OK, < 10% beating. No correction required
 - TCT alignment at end of squeeze (1m, sep.) & in collision. *J. Wenninger, R. Assmann, S. Redaelli*
 - Loss maps and asynchronous dump - OK
 - Squeeze to 1 m smooth, but then **strong instability** (seemed mostly vertical) increase of octupoles restores lifetime

	OP 2011	Nominal	Tight	<u>Tight MD1 & 1 m β^*</u>	EOF study
TCP-IR7	5.7	6.0	4.3	4.0	4.0
TCSG-IR7	8.5	7.0	5.0	6.0	6.0
TCLA-IR7	17.7	10.0	7.1	8.0	17.7
TCT₃ IP1/5/8	11.8	8.3	5.9	26.0	11.8
TCSG-IR6	9.3	7.5	5.3	7.0	7.0
TCDQ-IR6	9.8	8.0	5.7	7.5	7.5



- The physical aperture around the triplets in the IPs was found to be larger than initially assumed (see *Stefano's in ses.4*)
- **Decision in LMC:**
 - Continue running with same collimator settings as before the TS
 - TCTs IR1, 5 and 8 @ 11.8 σ
 - Stay with the crossing angle of 120 μrad





- Proposed ramp up for stable beams:

All in 4 days!

— 48b short fill → 84b fill, with combined long range beam-beam studies

– 264 - short fill

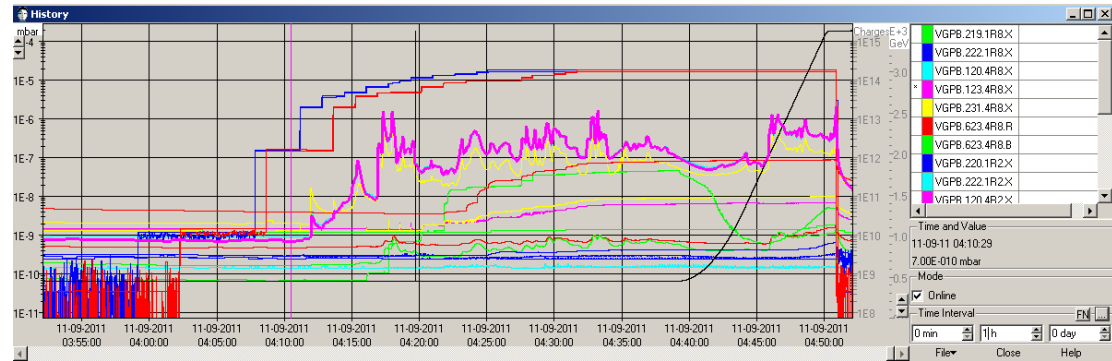
– 480 - short fill

– 912 - long fill

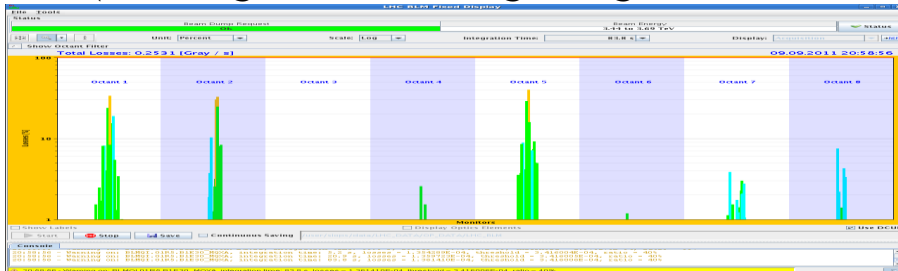
– 1380 - finally --> $2.98e33 \text{ cm}^{-2}\text{s}^{-1}$

Loss maps and asynchronous dump test for ALPHA and TOTEM
 TOTEM: 14 sigma in V, 18 sigma in H.
 ALFA: 7 mm from beam-based alignment center (18-21 sigma).
 1h data taking for ALFA-ATLAS

- Vacuum activity re-started to “annoy us”. 2 dumps due to losses at the TCTV.4R8 and ALICE could not switch on in SB



- Losses in collision (warning: we started getting used to the orange...)



e-cloud solenoid in 2R

- And many other problems.....



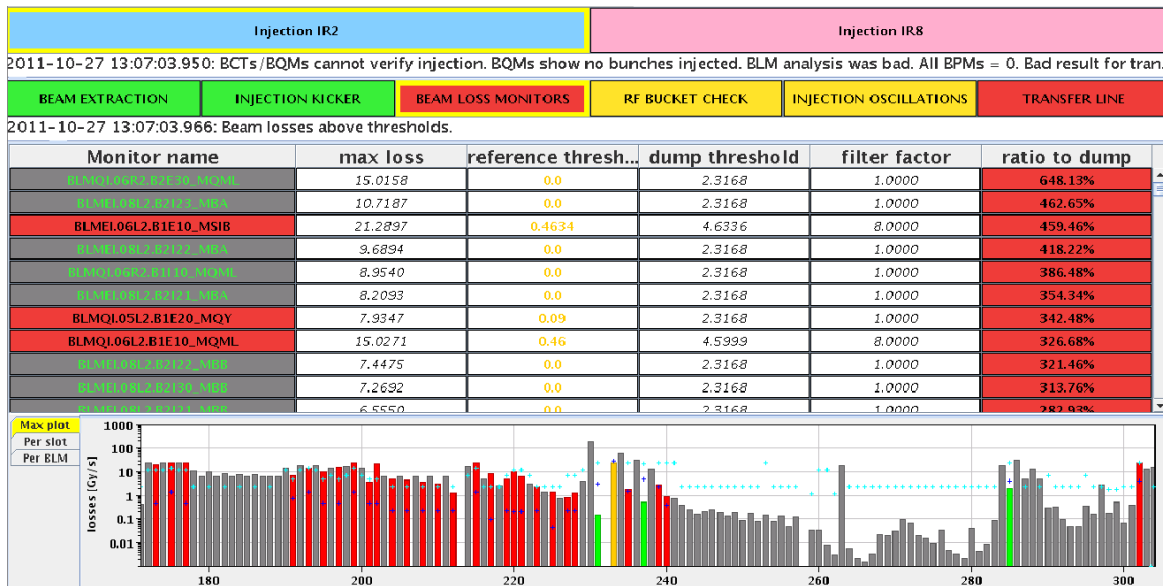


Her Excellency Mrs Pratibha Devisingh Patil President of India

THE SEE “QUENCH” DURING THE FIRST INJECTION OF 144B-SAT



- First injection of 144 bunches with satellites, B1
- Losses on ring BLMs factor 6.5 above dump level!
- Most likely due to injection problems in the SPS, blowing up the beams, and “corrected” by reduced scraping.
- Subsequent injections with satellites were very clean
- Reiner:
 - The magnet quench is indeed due to a spurious self-trigger of a quench heater discharge power supply. Such an event has not been observed so far in LHC, also not during radiation test campaigns.



FIRST STABLE BEAMS WITH 25NS-SPACED BUNCHES



VLC media player

File View Settings Audio Video Navigation Help

LHC Page1 Fill: 2186 E: 3500 GeV 07-10-2011 05:24:07

PROTON PHYSICS: STABLE BEAMS

Energy: 3500 GeV I(B1): 6.39e+12 I(B2): 6.33e+12

FBCT Intensity and Beam Energy Updated: 05:24:05

Instantaneous Luminosity Updated: 05:24:07

Comments 07-10-2011 05:23:51 :

*** STABLE BEAMS ***

PHYSICS fill with 25ns, 60b per beam

AFS: 25ns_60b+1small_58_36_36_24bpi4inj

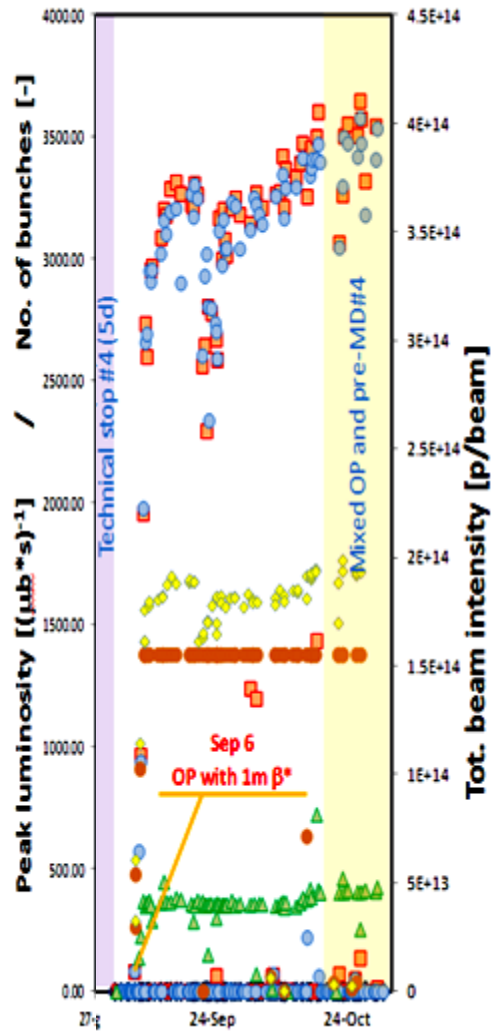
BIS status and SMP flags

	B1	B2
Link Status of Beam Permits	true	true
Global Beam Permit	true	true
Setup Beam	false	false
Beam Presence	true	true
Moveable Devices Allowed In	true	true
Stable Beams	true	true

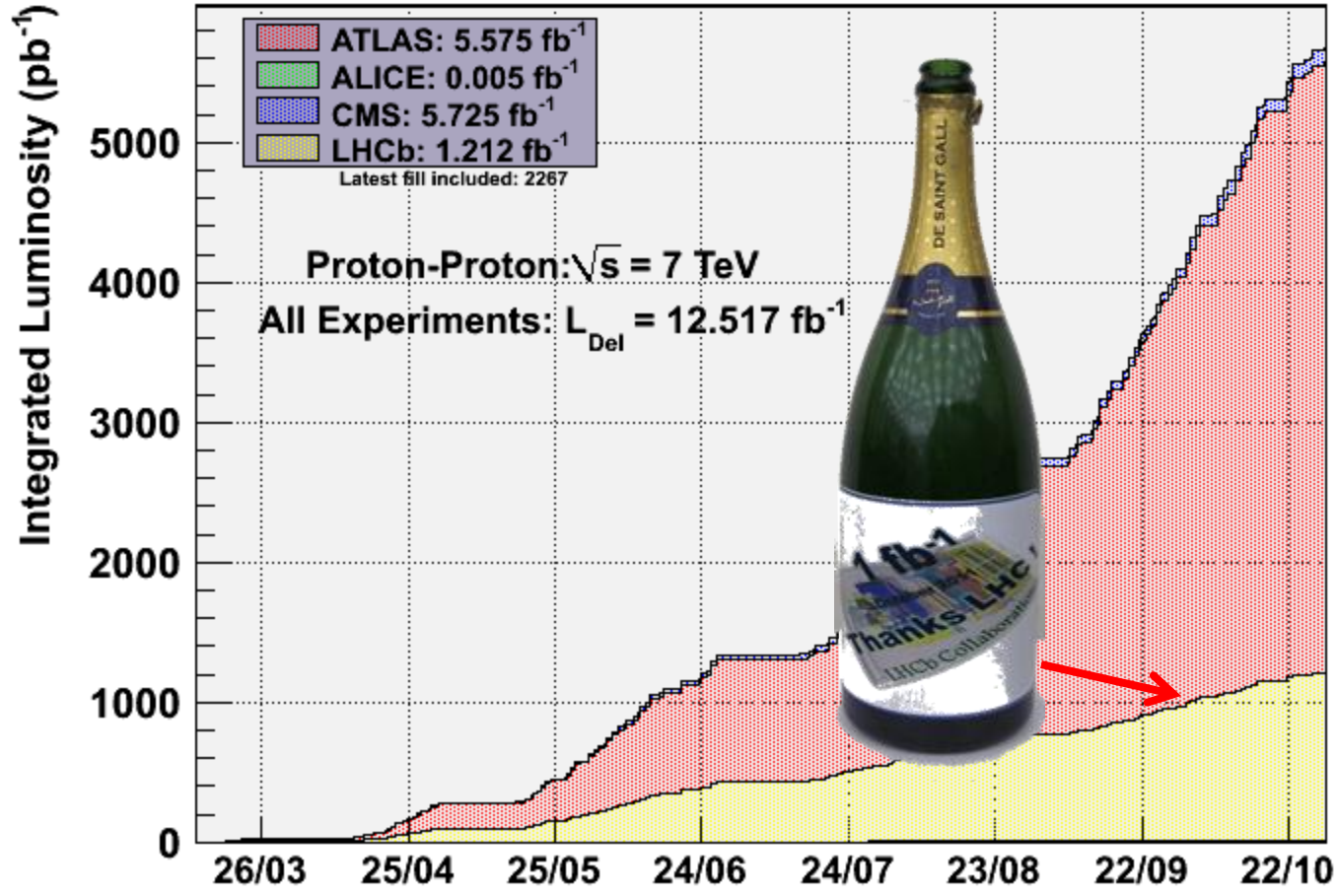
PM Status B1 ENABLED PM Status B2 ENABLED

0:00:00 / 0:00:00 | x1.00 | "LHC Page 1"

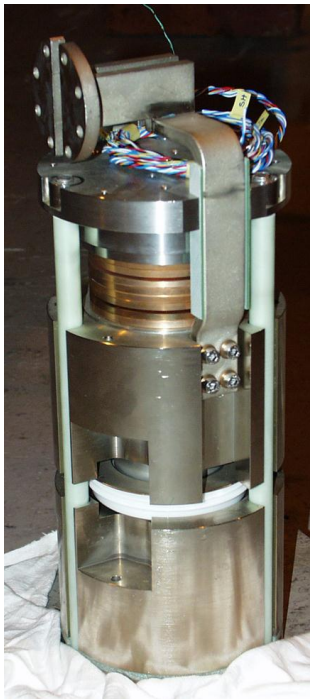




2011 Luminosity Production



- Recovery from TS was sometimes delayed by the powering tests (Matteo will go into details...).
 - Not all the times it is possible to test during the technical stop (cryogenics, UPSs, interference with tunnel activities,..)
 - For information, the tests executed during the TSs are **866**
 - Circuit revalidation after modification
 - ISRM measurements
 - Quench propagation test (2xdipoles, 2xmain quads)



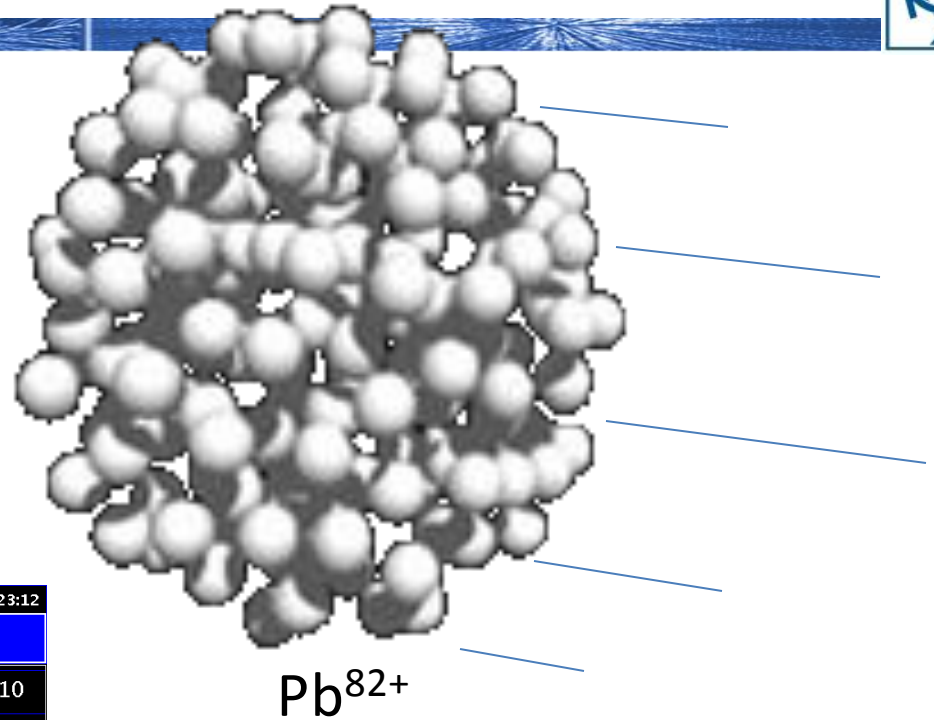
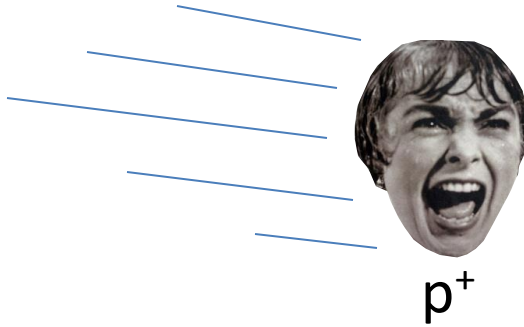
Dipole diode

ISRM

RIGHT				LEFT				
P1	DFBLB 02, 04, 05, 06 4	DFBAB 07, 08, 09, 10 4	DFBAC 07, 08, 09, 10 4	DFBFC 02 1	DFBFA 04, 05 1	P2		
P2	DFBLB 02, 04 1	DFBFC 01 1	DFBAD 07, 08, 09, 10, 11 4	DFBAE 0 0	DFBFD 0 0	P3		
P3	DFBFL 0 0	DFBFL 0 0	DFBAF 0 0	DFBAG 07, 08, 09, 10 4	DFBFG 0 0	DFBFH 04 1	P4	DFBHE 0 1
P4	DFBFL 0 1	DFBFL 04 1	DFBFG 05 1	DFBAH 07, 08, 09, 10 4	DFBAI 07, 08, 09, 10 4	P5		
P5	DFBLE 03, 04, 05, 06 4	DFBAJ 07, 08, 09, 10 4	DFBAK 08, 09, 10 3	DFBHI 05 1	DFBHI 04 1	P6		
P6	DFBHI 04 1	DFBHI 05 1	DFBAL 05, 06, 07 3	DFBAH 0 0	DFBHI 0 0	P7		
P7	DFBHI 0 0	DFBAK 0 0	DFBAO 07, 08, 09, 10 4	DFBHC 0 0	DFBFA 04, 05 1	P8		
P8	DFBIB 02, 04 1	DFBIJ 05 1	DFBIK 06 1	DFBAP 07, 08, 09, 10 4	DFBAA 07, 08, 09, 10 4	P1	DFBIA 02, 04, 05, 06 4	

Magnets' splices already measured
 Data analysed
 ISRM system installed and ready for measurements
 Test performed during machine down time

Status on: 04/11/2011
 Both ISRM systems (PXIELQA01 & 02) are stored in bld. 281



LHC Page1 Fill: 2269 E: 3500 GeV 31-10-2011 22:23:12

MACHINE DEVELOPMENT: FLAT TOP

Energy: 3500 GeV I(B1): 2.62e+10 I(B2): 1.86e+10

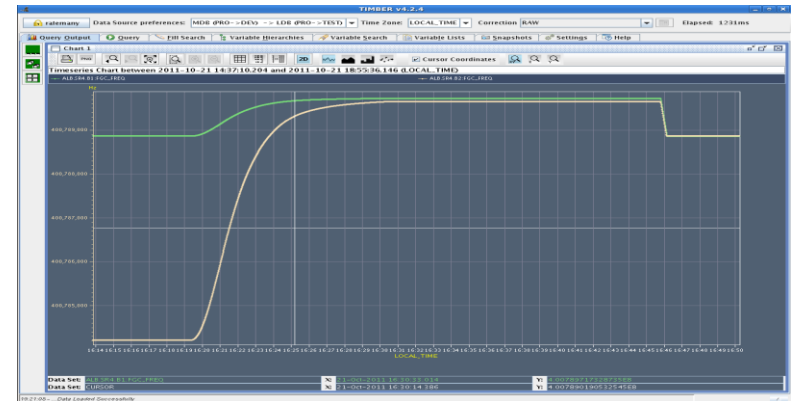
FBCT Intensity and Beam Energy Updated: 22:23:12

Comments 31-10-2011 21:55:27 :

2011 Proton physics program finished!
Proton and lead ion beams together for the first time at 3.5 Z TeV.
2 bunches each, will try rephasing RF.

BIS status and SMP flags	B1	B2
Link Status of Beam Permits	false	false
Global Beam Permit	true	true
Setup Beam	true	true
Beam Presence	true	true
Moveable Devices Allowed In	false	false
Stable Beams	false	false

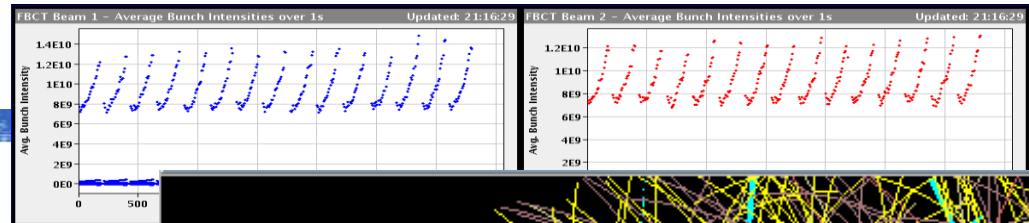
AFS: pPb_2b_1_1_1_1bpi2inj PM Status B1: ENABLED PM Status B2: ENABLED



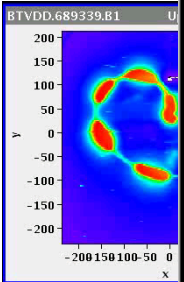
Proton-lead frequencies in ramp



THE HEAVY ION RUN

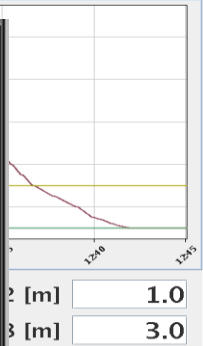
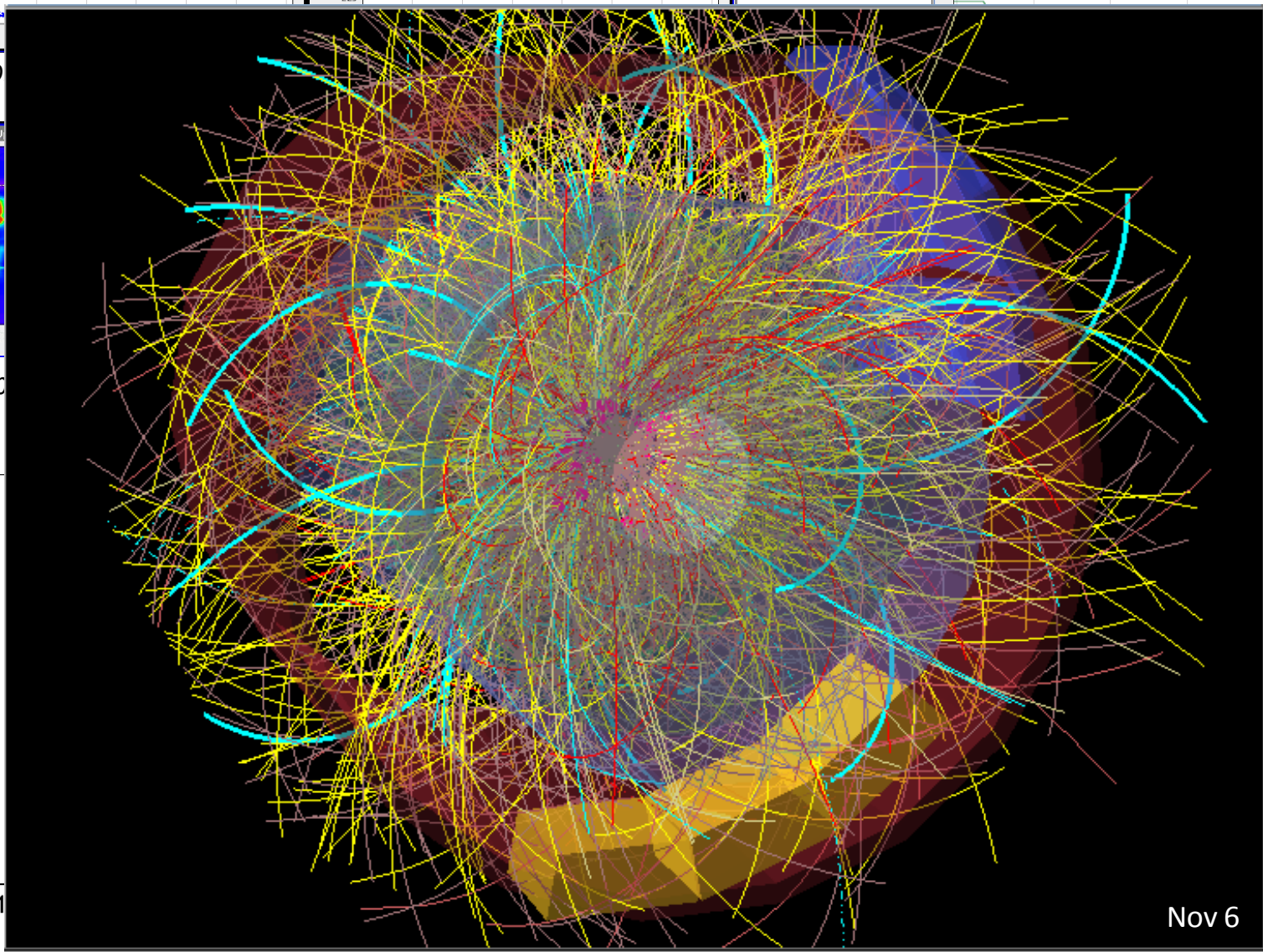


12 injectio

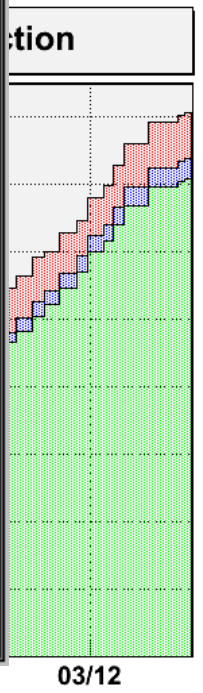


Abort gap

Total Integrated Luminosity [μb^{-1}]



2 [m] 1.0
3 [m] 3.0



Nov 6



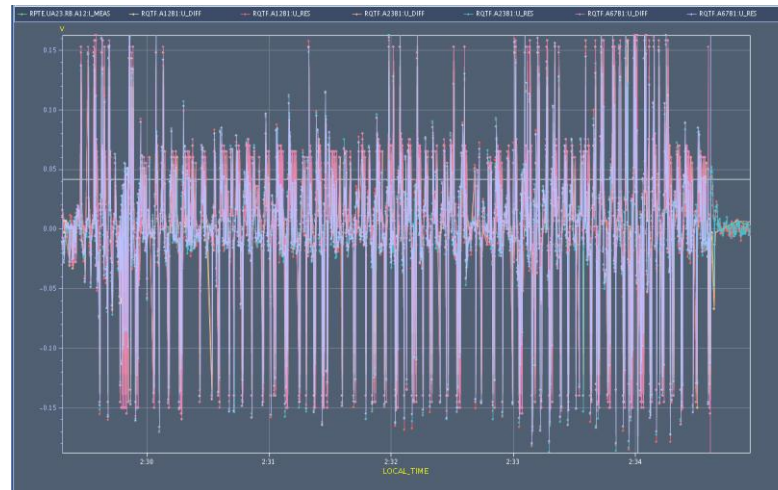


Thanks for the attention!!!

...even if not everyone is there, from OP/LHC, but also from the whole complex!



- Injection
- FB
- SEE
- Power cuts
- The configuration of the QFB should be stuck at the beginning of the year and all following modifications should be previously approved by OP.
- Beams dump twice in last two weeks QPS/tune feedback interplay
 - Feedback jumping between 50 Hz harmonics and tune and sidebands, QTF/QTD bouncing around... potential solution - change threshold change current of QPS (move tune, get rid of 50 Hz, check Q'...)



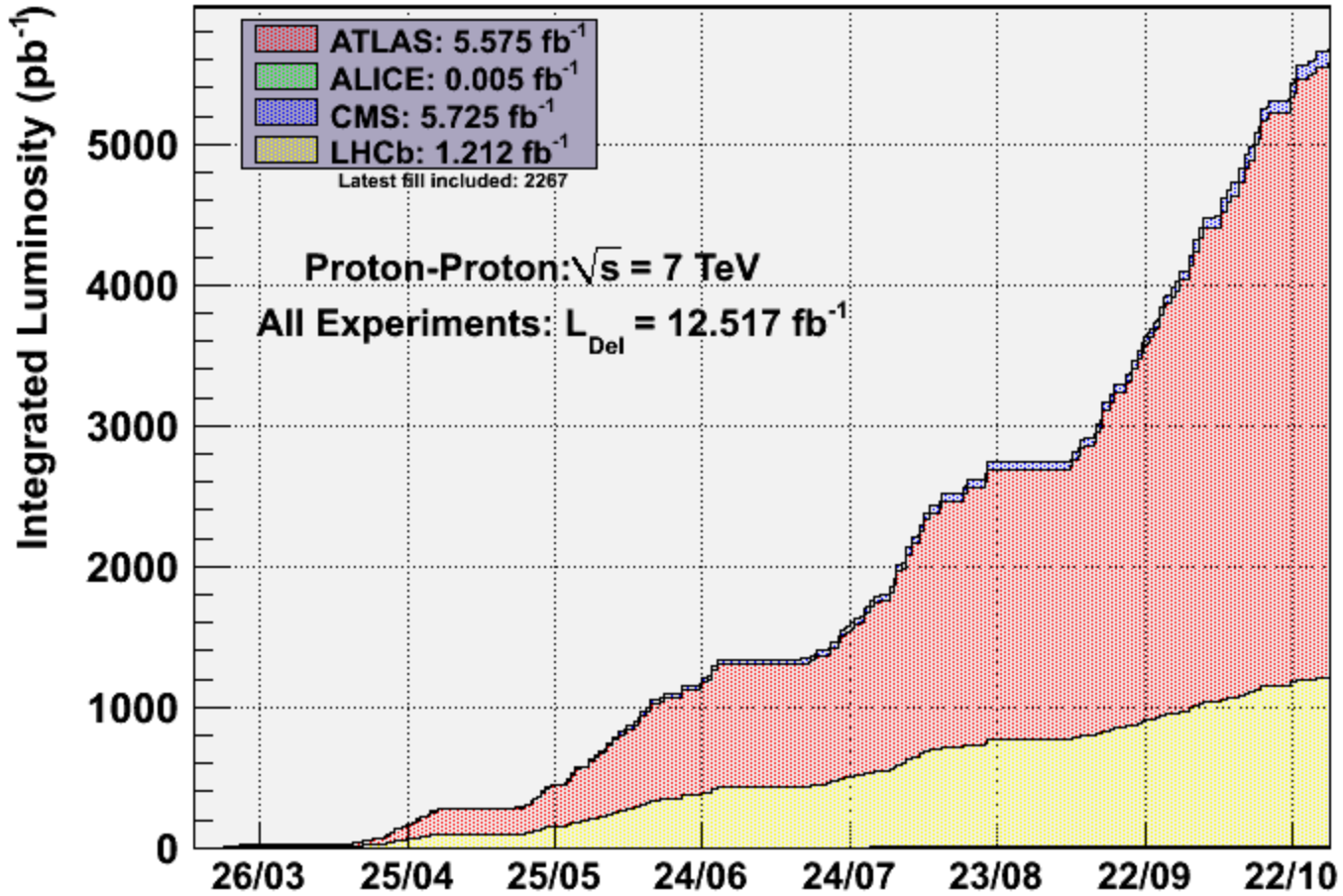
Voltage on RQTFs during squeeze



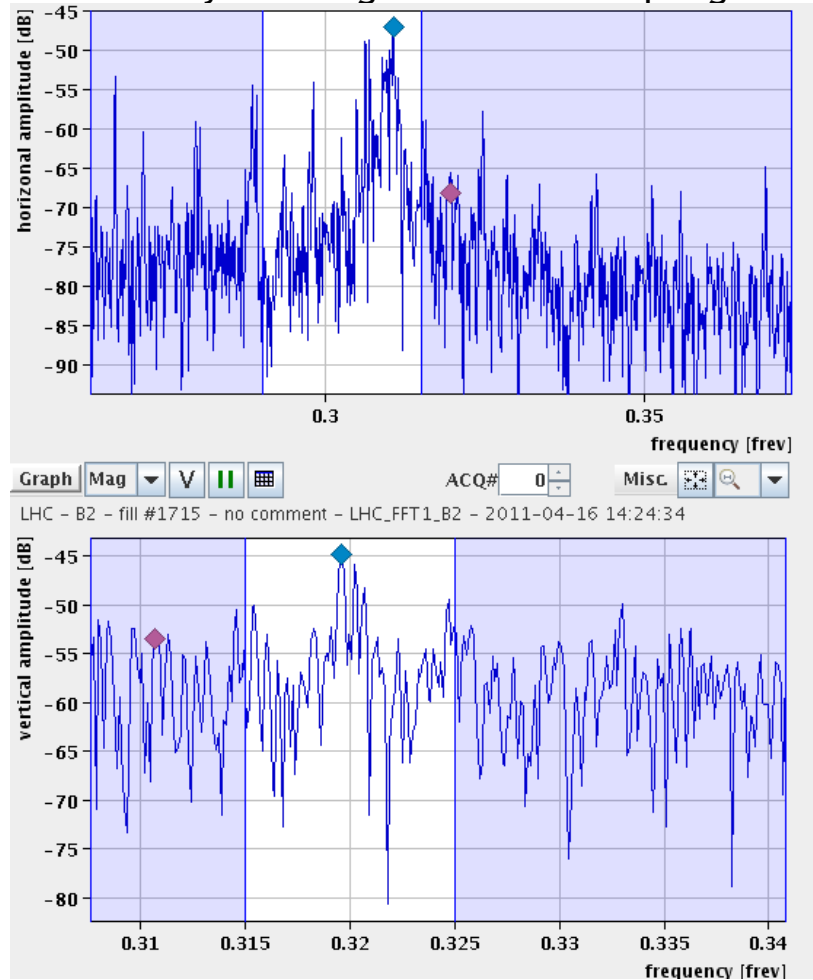
- Group masking for special purposes (loss maps, beta-beat,...) + procedures (may be a special sequence to prepare for the tests, also in the form of a checklist...)
- Sequence for loss maps...(nominal intensity, inj.prot.out, masks...)
- Page 1 to logbook
- Shifters automatically to logbook
- Starting new studies category
- Filling scheme to be sent to the logbook

A screenshot of a logbook form interface with a blue background. The form contains several input fields and buttons. At the top right is a yellow "SUBMIT" button. Below it is a yellow label "Operator comment" followed by a large white text area. Further down is a yellow label "Fault report" followed by a white text area. To the right of this area is a blue button labeled "Lists...". At the bottom is a yellow label "PAGE 1" followed by a large white text area.

2011 Luminosity Production

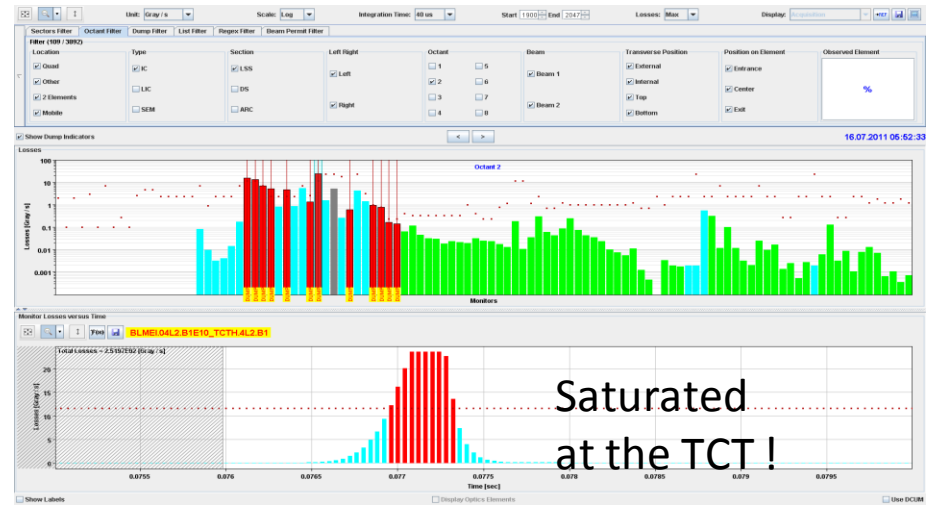


- Ramp with 228b → strong beam losses (all safe)
- Fixed by reduced chromaticity, increased damper gain, stronger octupoles in ramp.
- Establishing physics with 228b, 50ns. 3 fills, 20h.
- Losses at start of collision fixed by doubling transverse damper gain

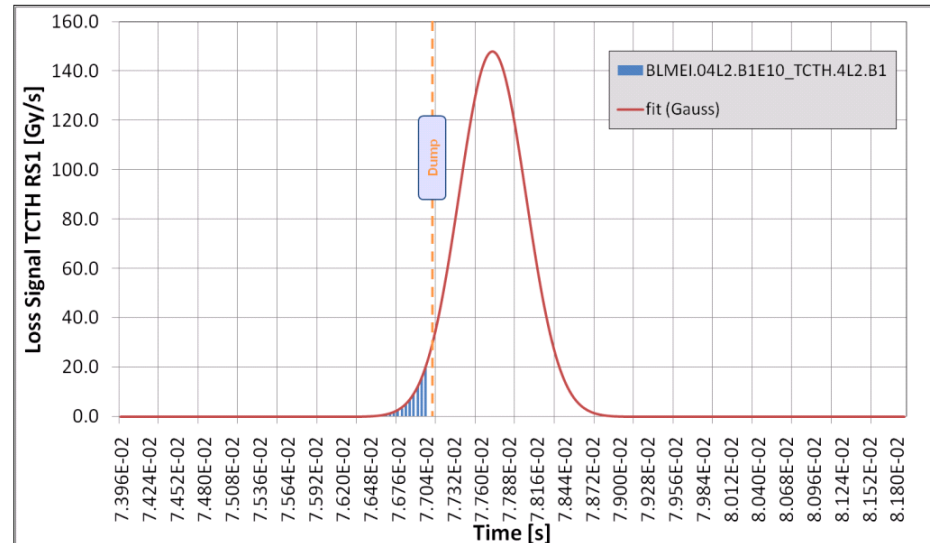




- A lot of UFO on MKI.D5L2.B1
- Later calming down
- Wait **one hour** before ramping...



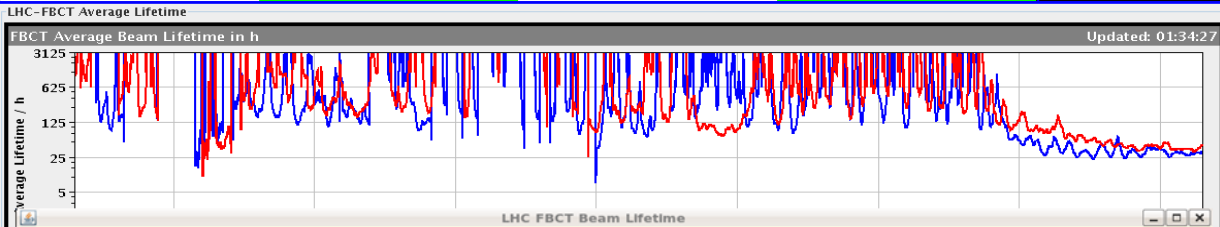
- Was the largest UFO ever seen.
- With a saturated signal at the TCT and an extrapolated amplitude of up to 148 Gy/s at the TCT
- The temporal width was 338us



WORKING POINT OPTIMIZATION

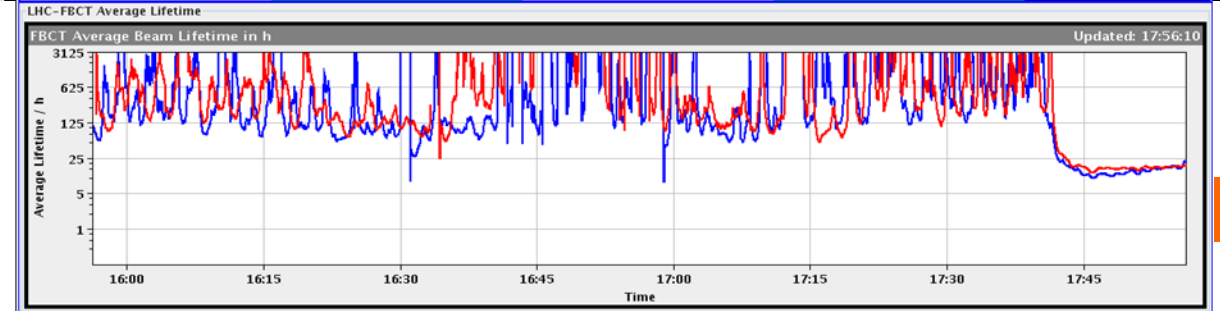


I(total) B1:	1.59e+14	I(total) B2:	1.58e+14	29-07-2011
Average lifetime B1:	31.07 h	Average lifetime B2:	42.51 h	01:34:27



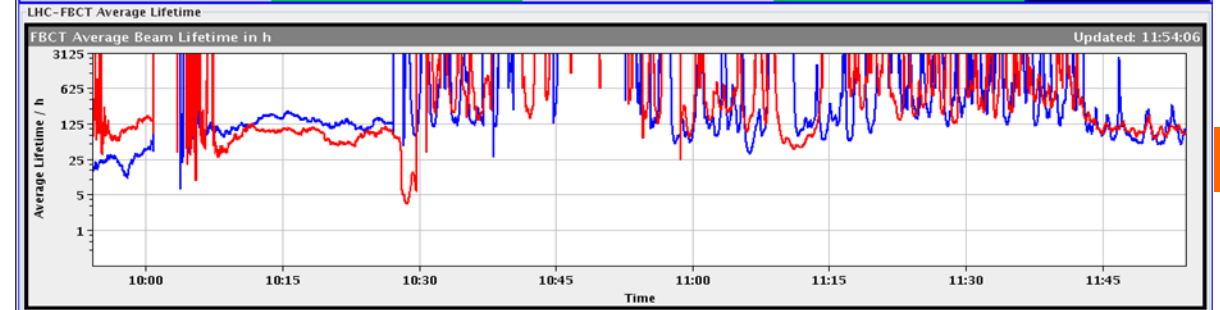
Fill 1990 - 0.31/0.32

I(total) B1:	1.61e+14	I(total) B2:	1.60e+14	29-07-2011
Average lifetime B1:	21.86 h	Average lifetime B2:	17.19 h	17:56:11

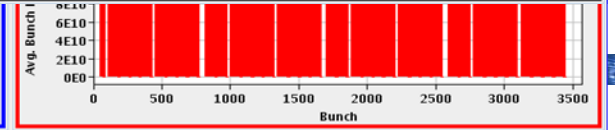
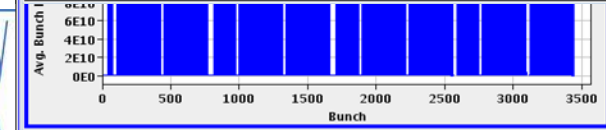


Fill 1991 - 0.308/0.318

I(total) B1:	1.66e+14	I(total) B2:	1.64e+14	30-07-2011
Average lifetime B1:	97.68 h	Average lifetime B2:	84.61 h	11:54:06



Fill 1992 - 0.312/0.322



24B INJ WITHOUT AND WITH 800 MHz CAVITY IN SPS



LHC Injection Quality Check

File Mask Help
LHC Injection Quality Check

▼ RBA: lhcop Beam 1: Beam 2: Last injection: Beam 2

2011-04-04 10:39:0

BEAM EXTRACTION
Injection IR2
Injection IR8

2011-04-04 10:39:0
2011-04-04 11:12:38.750: Beam injected! BQMs: Injected 24 bunches(56 bunches circulating).

BEAM EXTRACTION
INJECTION KICKER
BEAM LOSS MONITORS
RF BUCKET CHECK
INJECTION OSCILLATIONS
TRANSFER LINE

2011-04-04 11:12:38.758: Ring losses are within thresholds.

Monitor name	max loss	reference thres...	dump threshold	filter factor	ratio to dump
BLMEI.04R8.B2E20_MSXB	0.6442	0.0	23.1680	1.0000	3%
BLMEI.04R8.B2E20_TDL4R8.B2	0.4745	1.5	23.1680	180.0000	2%
BLMEI.05R8.B2E20_MQXB	0.0404	0.0	2.3168	1.0000	2%
BLMQI.05R8.B2E20_MQXA	0.0365	0.0	2.3168	1.0000	2%
BLMEI.04R8.B2E20_TCTH4R8.B2	0.0464	0.0	2.3168	1.0000	2%
BLMEI.04R8.B2E20_MBXB	0.1758	0.4	23.1679	1.0000	1%
BLMEI.06R8.B2E20_MSIB	0.0254	0.46	4.6336	8.0000	1%
BLMQI.05R8.B2E20_MQY	0.0790	1.38	13.7999	1.0000	1%
BLMEI.05R8.B2E20_MKI.D5R8.B2	0.0195	0.12	2.3168	1.0000	1%

Max plot

Per slot

Per BLM

Max plot

Per slot

Per BLM

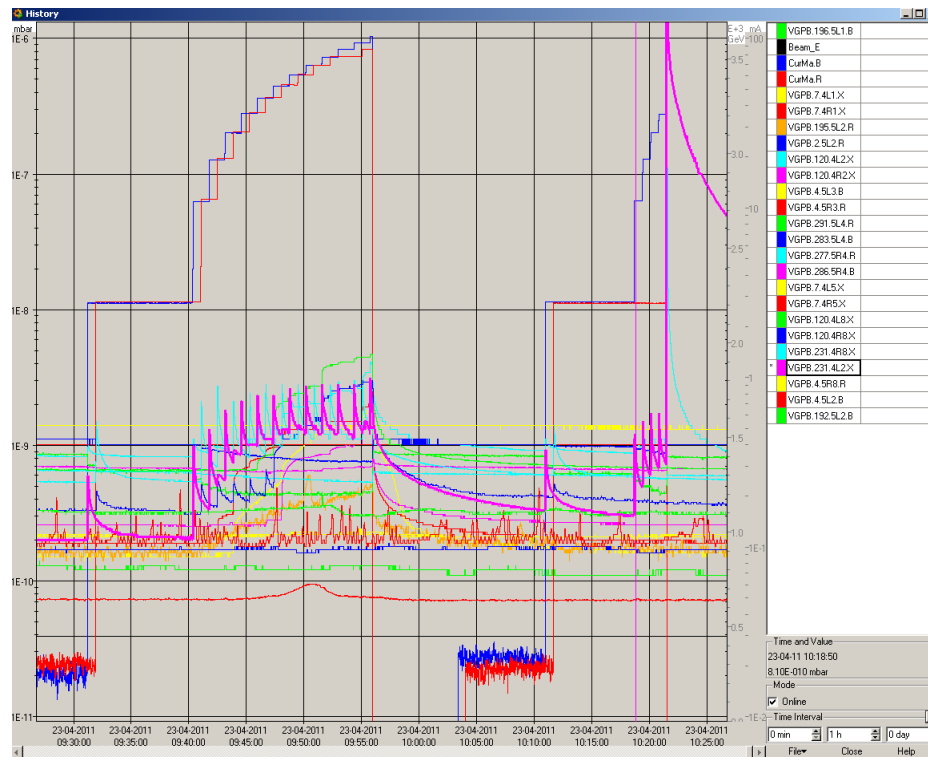
Successful! The Gy factor was NO MONITOR

Slot:

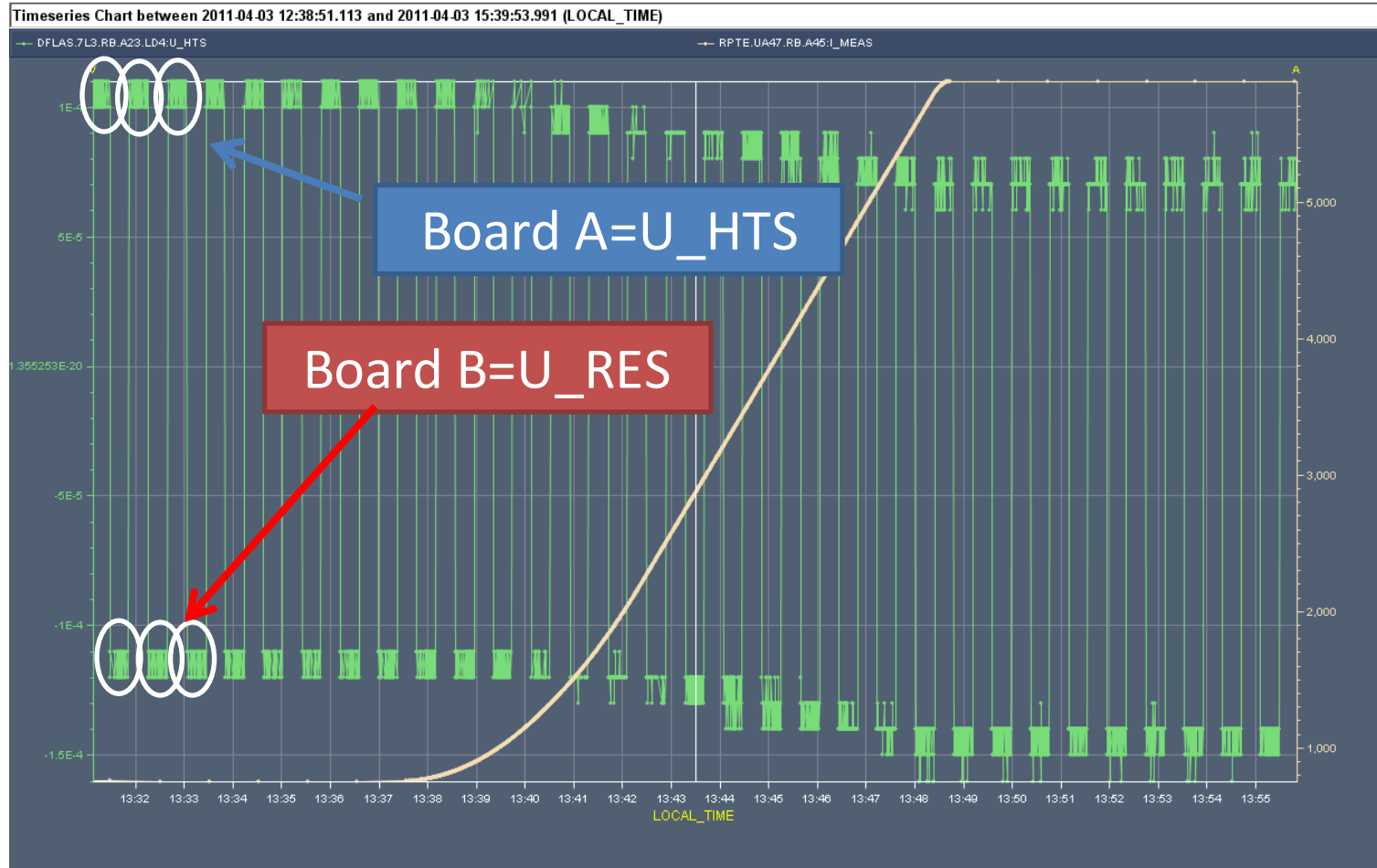
Get last result: B1

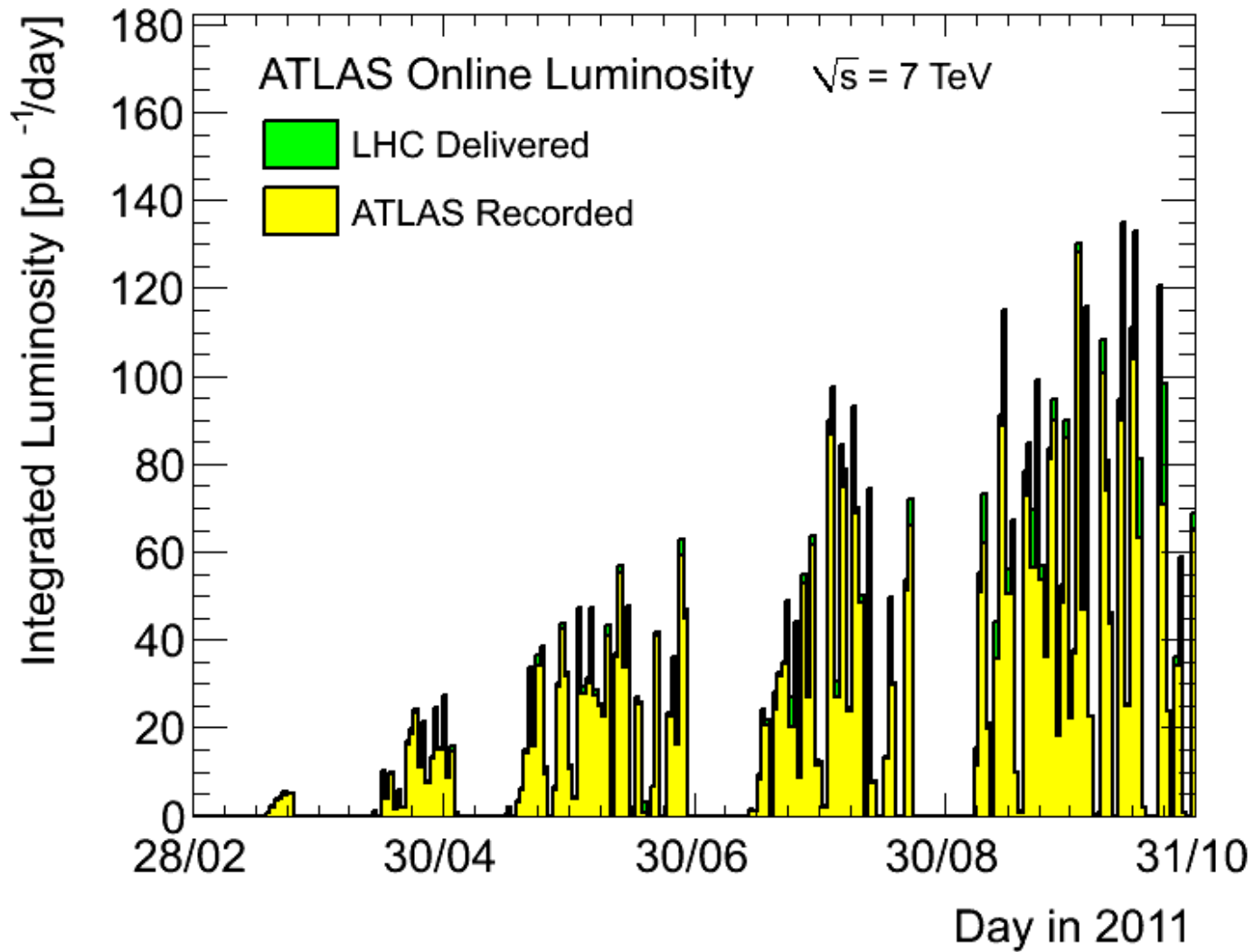
10:43:27 - Beam injected! BQMs
11:12:57 - Beam injected! BQMs: Injected 24 bunches(56 bunches circulating).

- Missing pre-pulse from LHC RF distribution while injecting Beam 1 only → logging to be implemented to understand behaviour in the future
- Beam (36 bunches) on TDI → ALICE detector triggered the beam dump+BLMs
- Vacuum valves closing near to TDI due to outgassing. Fast recovery.



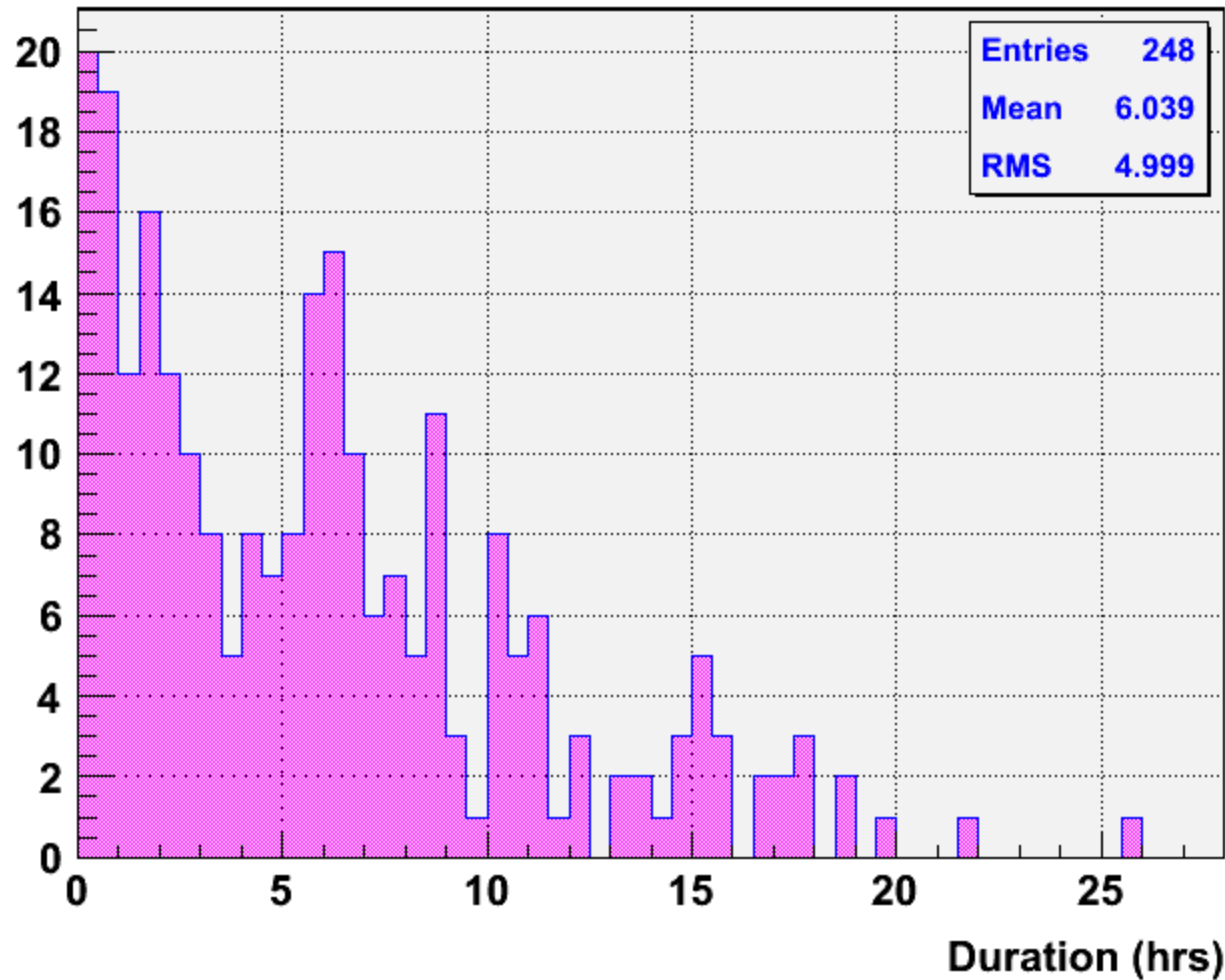
VERIFICATION AFTER THE CURRENT LEAD QUENCH – APR 7







Duration of Fills with Stable Beams

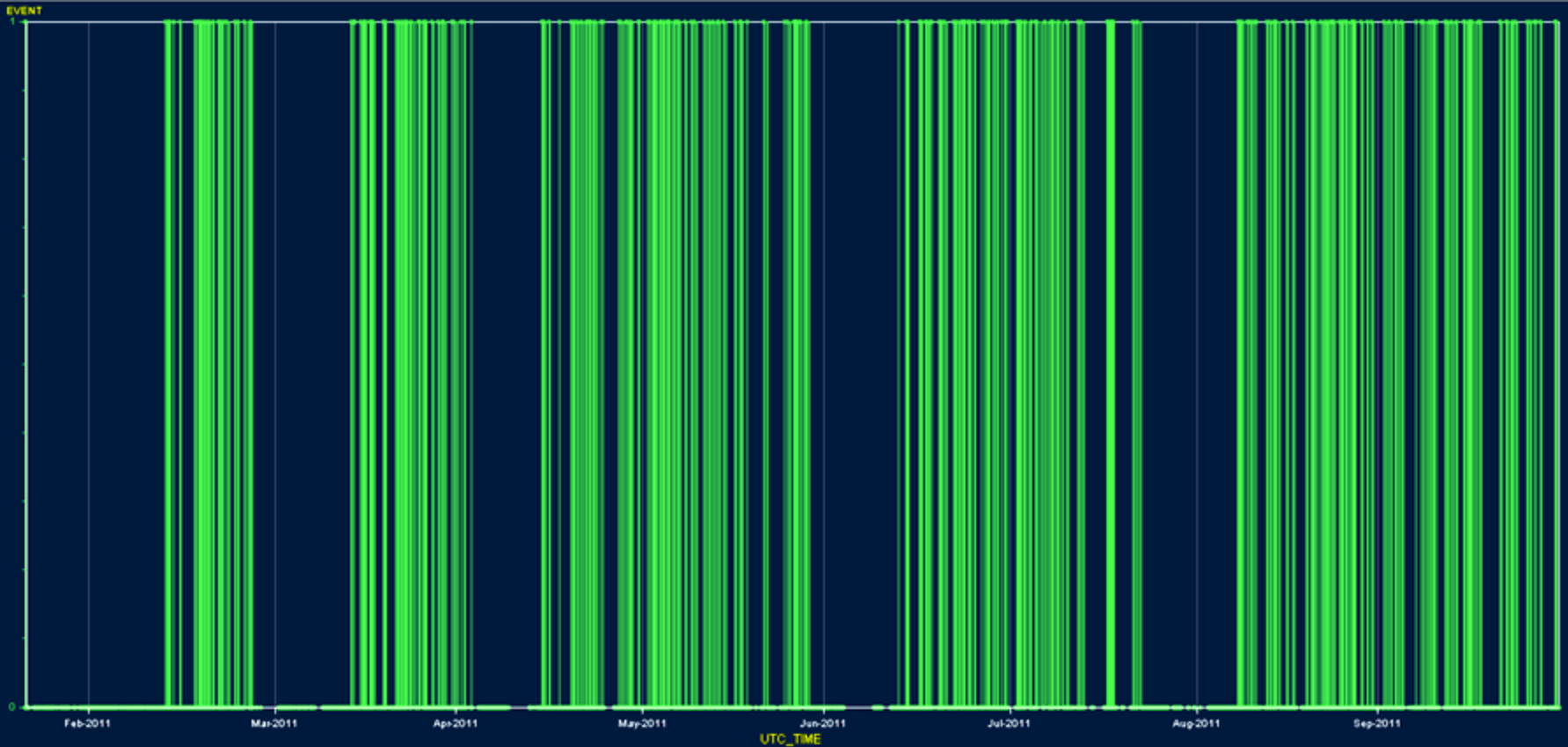


MACHINE AVAILABILITY: STABLE BEAM PERIODS



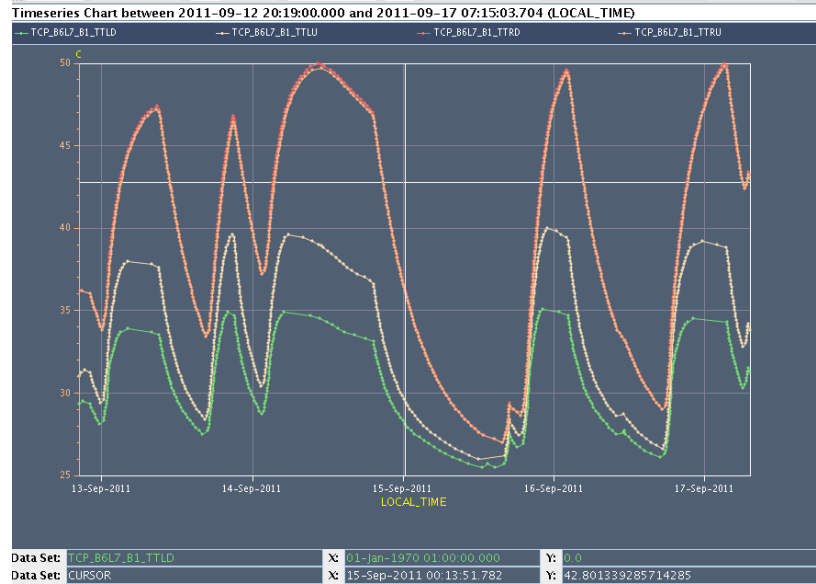
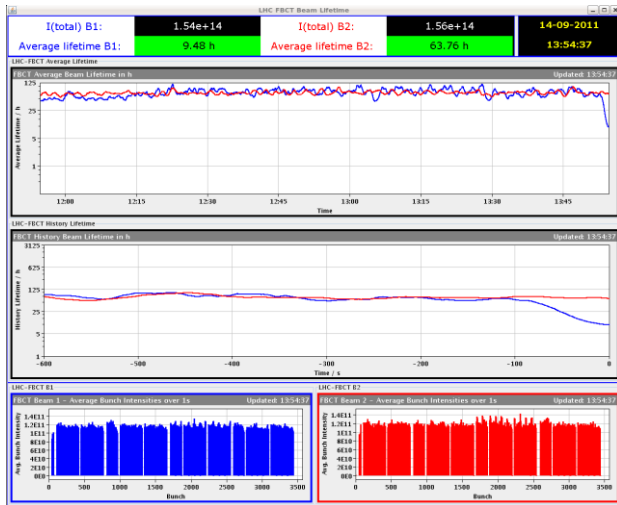
Timeseries Chart between 2011-02-18 00:00:00.000 and 2011-10-31 00:00:00.000 (UTC_TIME)

■ MK.BMODE_STABLE

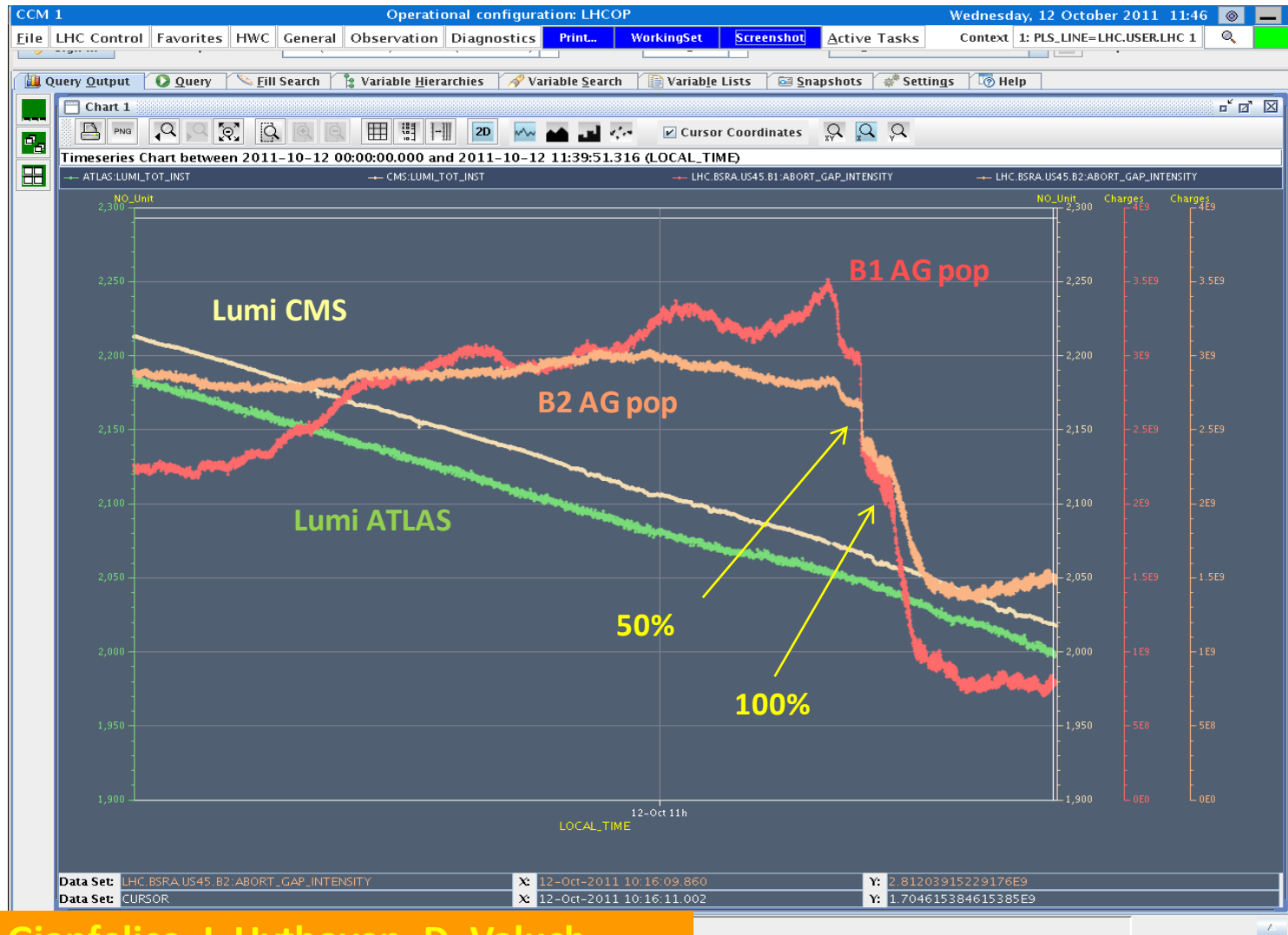


Collimator jaw temperature

RF noise issue?



ABORT GAP CLEANING TESTS



E. Gianfelice, J. Uythoven, D. Valuch

