

LHC Status Week 11 2011

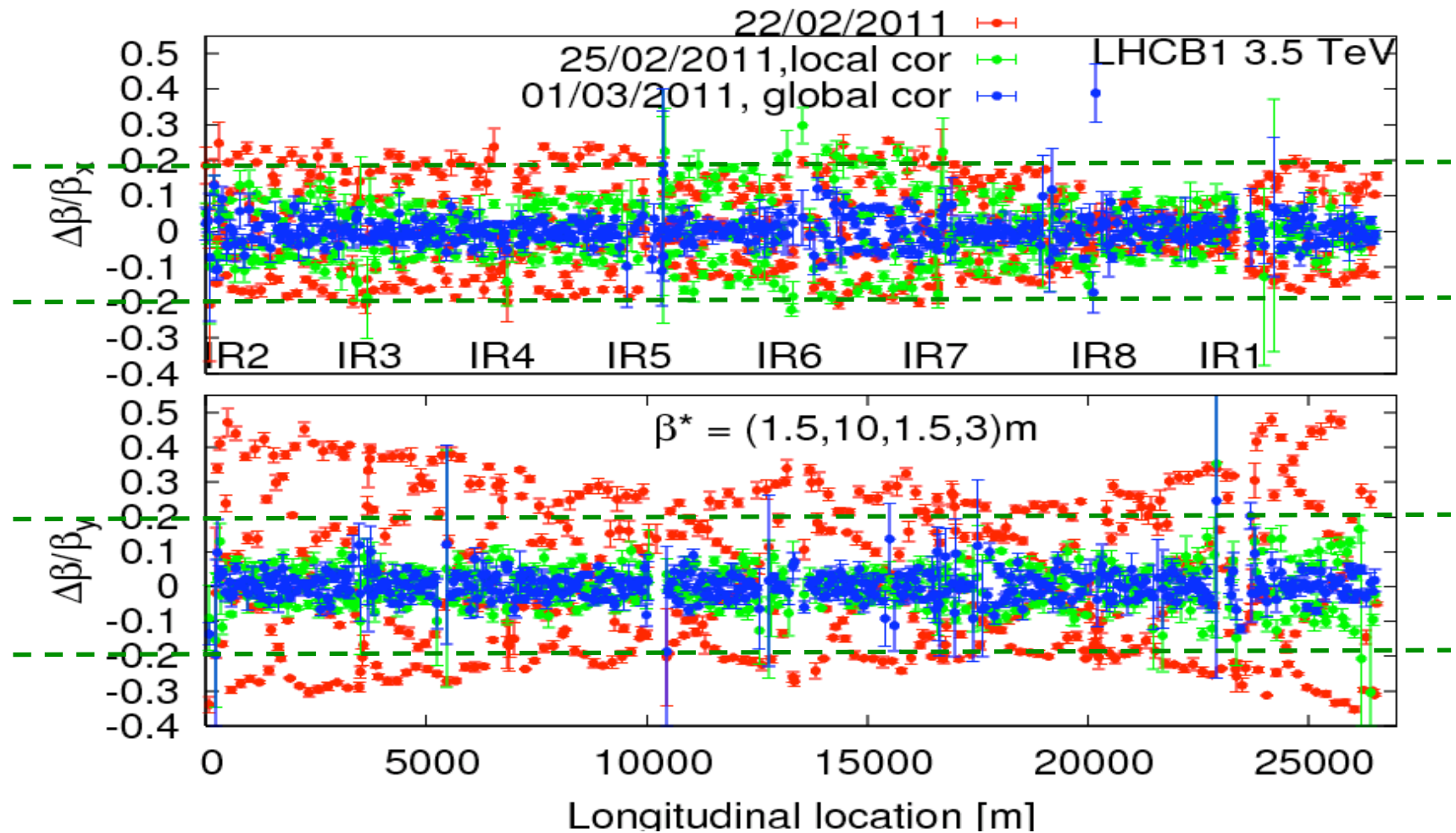
Bernhard Holzer

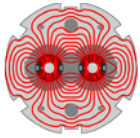
*... the good news 1: **there is progress***

*... the good news 2: **there are still (more than) enough problems to keep us busy !***

Summary of Week 10 (Commissioning)

Ramp to 3.5 TeV, squeeze to 1.5m : *Optics: measured & corrected, $\Delta\beta/\beta \approx 10\text{-}20\%$*
Orbit ok (about IP8 we don't talk anymore)
Coupling: compensation at intermediate steps



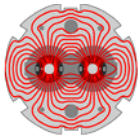


Latest β^*

- 'Final' β^* values from K-modulation:

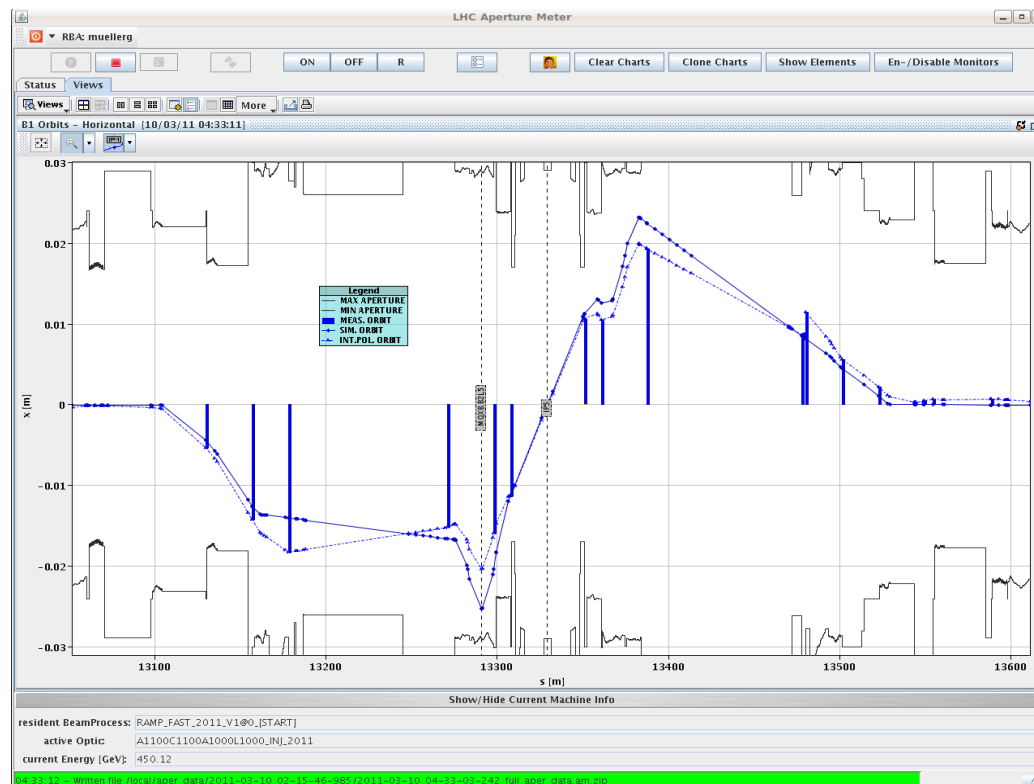
| Beam/plane | IR5 | IR1 |
|------------|------|------|
| B1H | 1.50 | 1.53 |
| B2H | 1.48 | 1.57 |
| B1V | 1.52 | 1.50 |
| B2V | 1.52 | 1.57 |

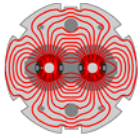
- Measurement errors around 4-10%.
- Imbalance is 2.5 +/- 8% in favor of CMS.



Aperture at IR's

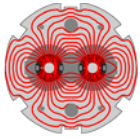
- The local triplet aperture was verified with local bumps, the beam edge is defined by a TCP – preliminary results
 - IR1 V B1: 16 sigmas 16 in prev. meas.
 - IR1 V B2: 14 sigmas 15 in prev. meas.
 - IR5 H B1: 13.5 sigmas 15 in prev. meas.
 - IR5 H B2: 13 sigmas 17 in prev. meas.





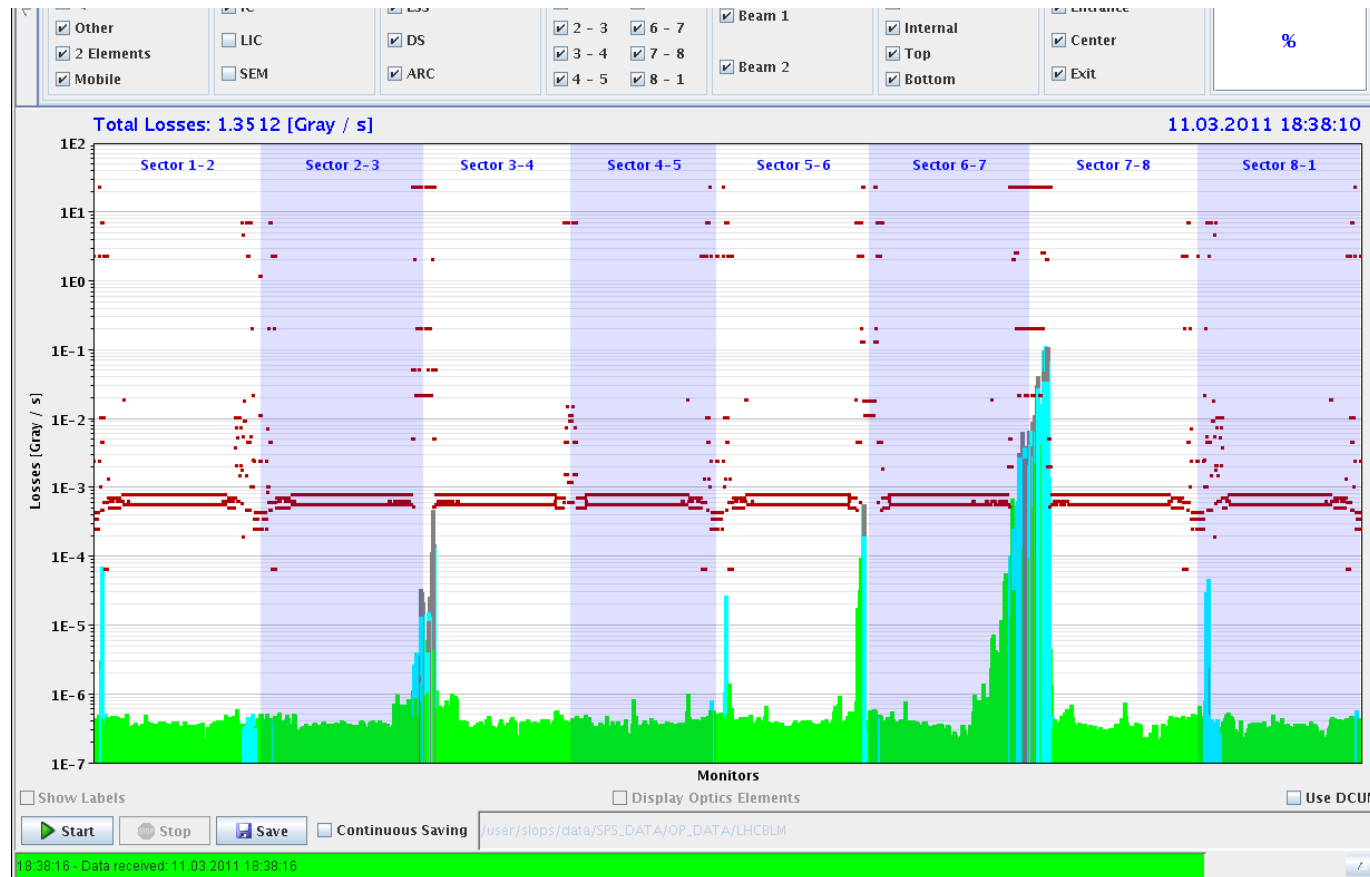
End of fill studies @ 3.5 TeV collisions

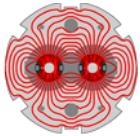
- Betatron loss maps B2 H & V
 - First impression ok
- “Asynch dump” test B2
 - The ratio of losses on the TCTs/cold elements to TCDQA was $3e-4$ for B1, and $4e-4$ for B2, assuming a filter factor of 60 on the TCDQA BLM. This is fine (BG).
- FMCM tests by generating an FGC_STATE fault in the related power converters
 - Analysis off-line
- Automatic BLM-BIS test
 - All tests passed ok



Loss maps

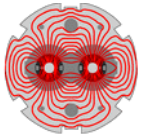
- Example of a betatron loss map @ 1.5 m beta*



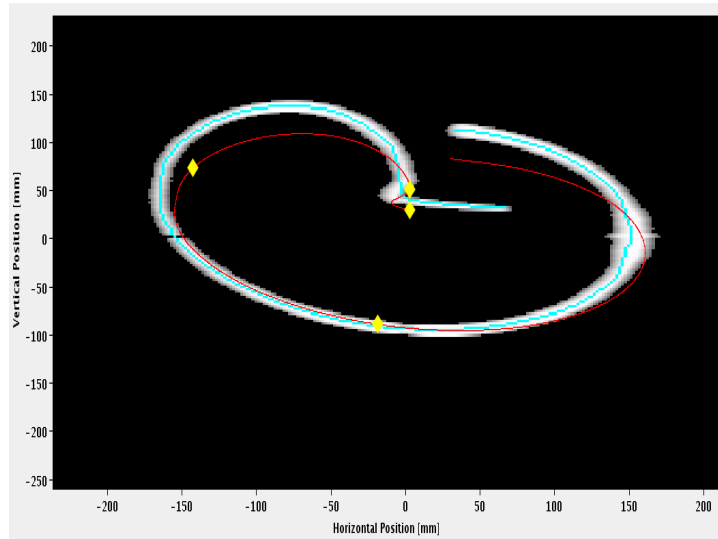


Validation results - collimation

- Preliminary of qualification tests (R. Assmann):
 - Highest losses always at primary collimators.
 - Leakage to cold magnets at $1e-4$ level.
 - Leakage to TCT's at $1.5m$ beta* as expected ($1e-3$ level).
 - Leakage to TCTV's in IR1 and IR8 is at $1e-2$ level for off-momentum loss maps. H collimators in IR3 produce a vertical halo that is intercepted at the vertical tertiary collimators. OK.
 - No leakage of losses to the triplets observed.
 - Interlock thresholds have been set.
- **Summary:** collimator and protection hierarchy is qualified for $1.5m$ beta*. The triplets are protected and the TCT's are safe themselves.

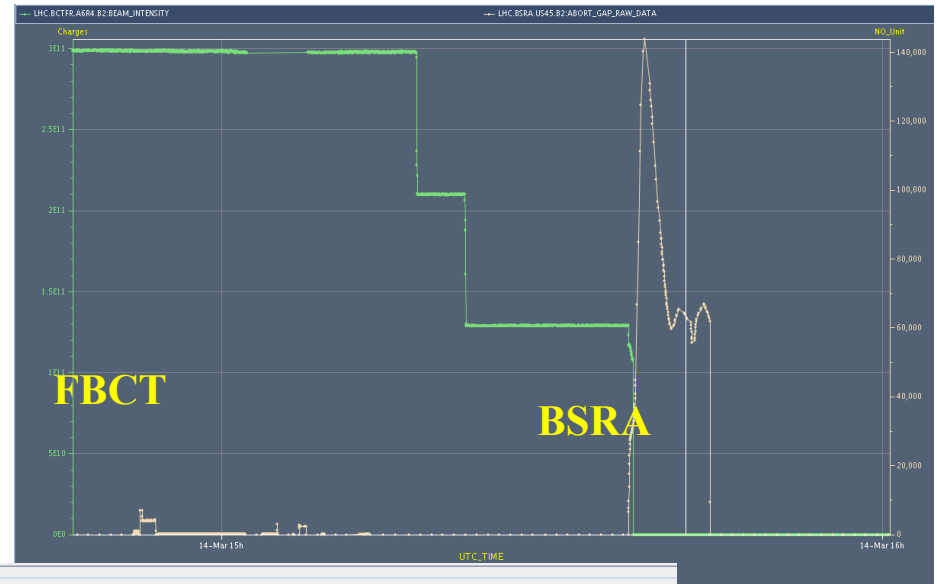


“Asynch Dump” test

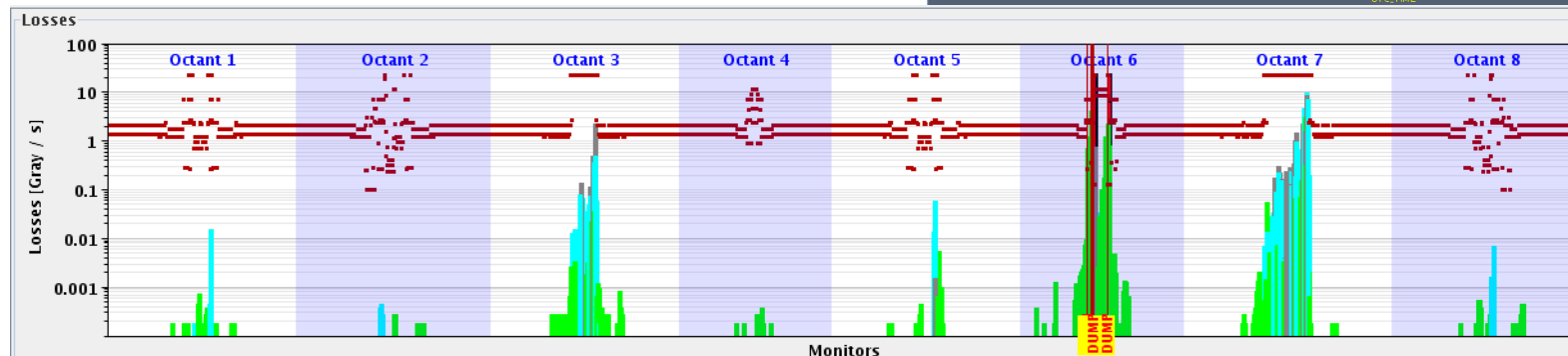


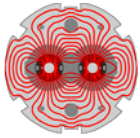
Beam profile at dump
ADD

Abort gap monitoring
BSRA



BLMs





End of fill studies @ 3.5 TeV collisions

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 - First impression ok
- “Asynch dump” test B2
 - The ratio of losses on the TCTs/cold elements to TCDQA was $3e-4$ for B1, and $4e-4$ for B2, assuming a filter factor of 60 on the TCDQA BLM. This is fine (BG).
- *FMCM tests by generating an FGC_STATE fault in the related power converters*
 - Analysis off-line
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Possible Weakness of the LHC MPS:

Analysis of fast beam losses (A. Gómez)

Short Summary of the studies:

quench in sc. arc dipoles: $\tau_{loss} = 20 - 30 \text{ ms}$

BLM system reacts in time, QPS is not fast enough

quench in sc. arc quadrupoles: $\tau_{loss} = 200 \text{ ms}$

BLM & QPS react in time

failure of nc. quadrupoles: $\tau_{det} = 6 \text{ ms}$

$\tau_{damage} = 6.4 \text{ ms}$

failure of nc. dipole:

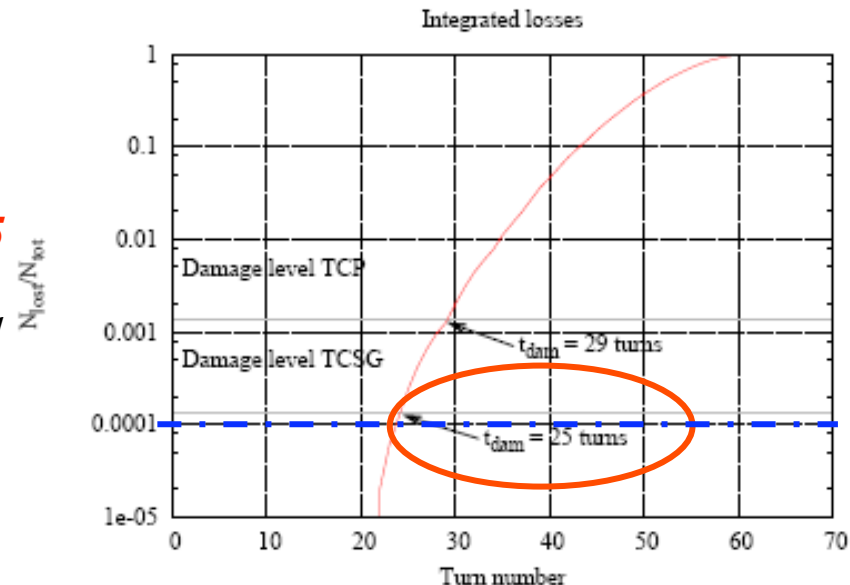
$\tau_{damage} = 2 \text{ ms}$

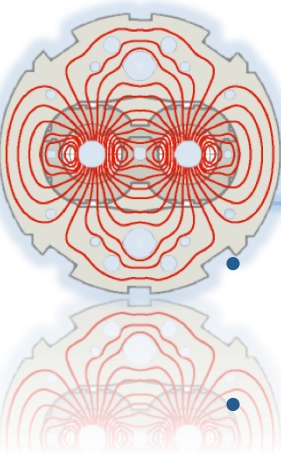
→ **FMCM installed**

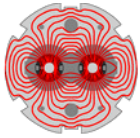
worst case: nc. dipole magnets: RD1.LR1 / LR5

**simulation of beam losses due to failure of RD1
damage level reached after 25 turns**

$\tau_{BLM \text{ react.}} \approx \tau_{damage}$



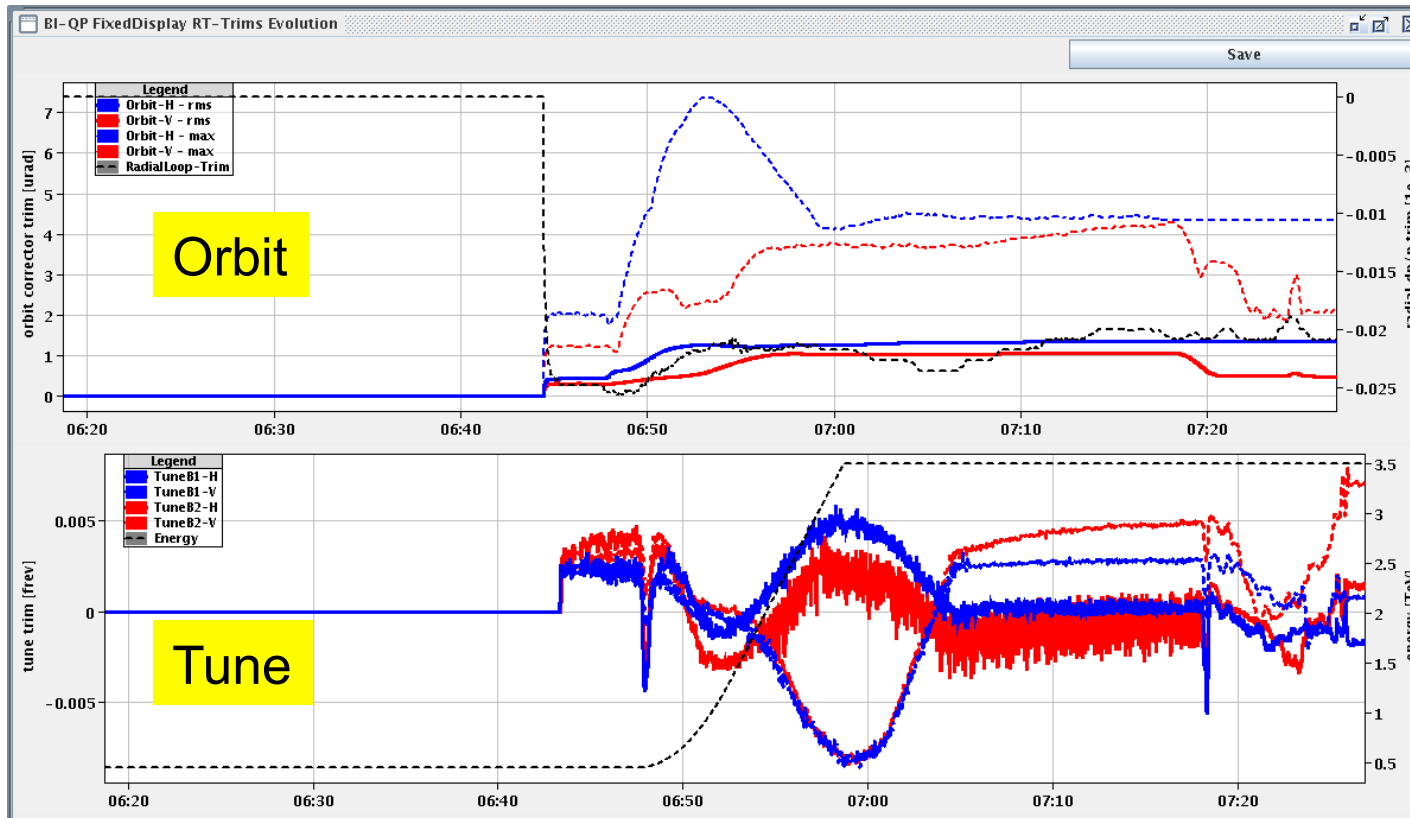
- 
- 08:00 - 12:00: Machine protection checks without beam: BLMs/XPOC/IPOC
 - 12:00-16:30 Test ramp with 8 bunches (and 4 pilots) **failed due to trip of trim quadrupole**
 - 16:30-21:30 - MPS checks:
 - BLM tests with beam
 - D1 trip and protection by BLM
 - Dump BTV interlock tests
 - LSS interlocked BPMs
 - OK from rMPP to go to 32 on 32 bunches
 - 21:30 - 23:30 Test ramp with 8 bunches (75 ns spacing) **failed due to trip of trim quadrupole at flat-top**
 - 23:30 - 02:00 Ramp and squeeze 3 on 3 with damper ON through all the squeeze and reduced gain - Validation of the behaviour of the damper during the squeeze.
 - 02:00 - now stable beams
-



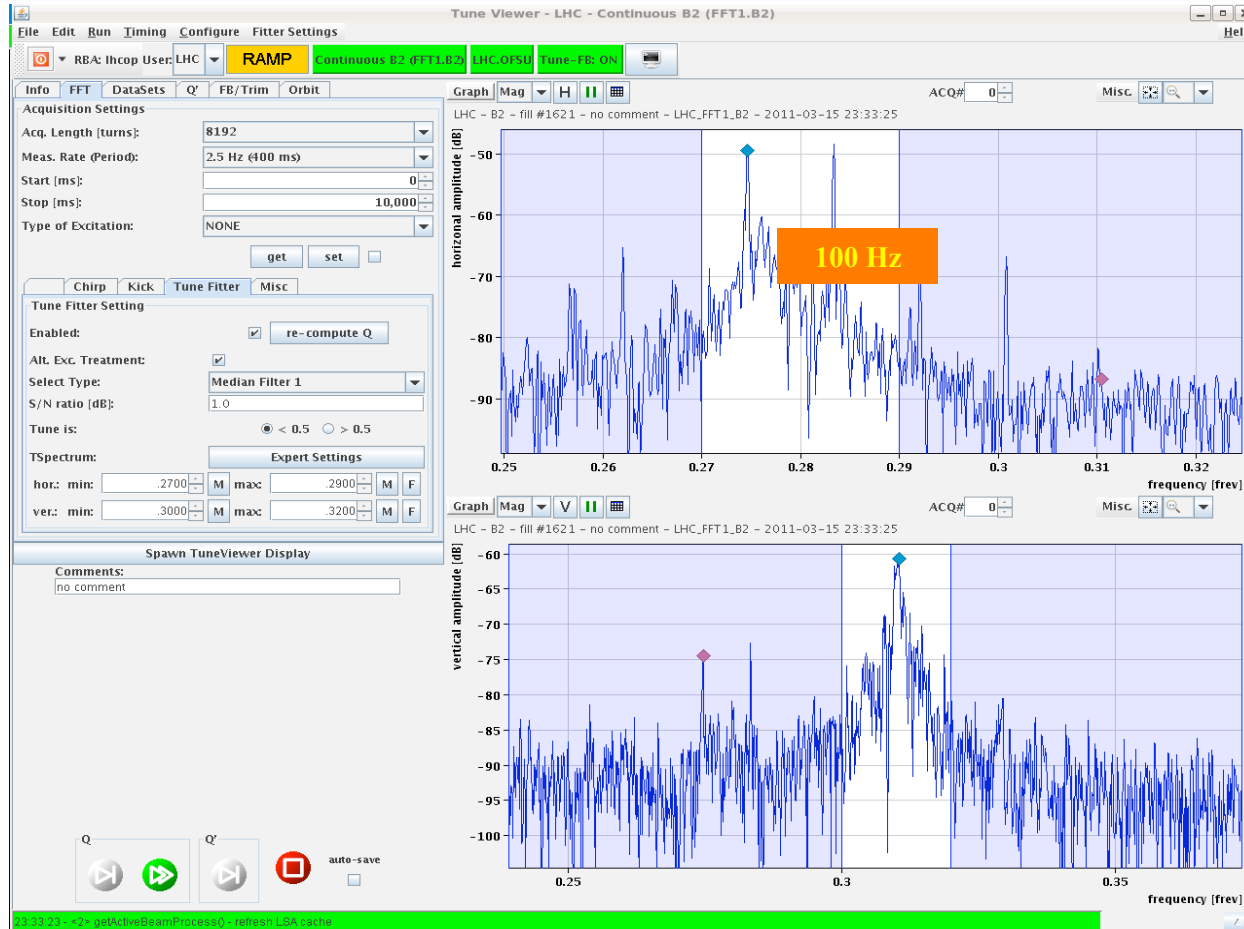
Ramp & squeeze

- Ramp & squeeze cleaned and consolidated.
 - Orbit corrector functions entirely cleaned on Thursday.

RT trims



Test ramp with 8 bunches



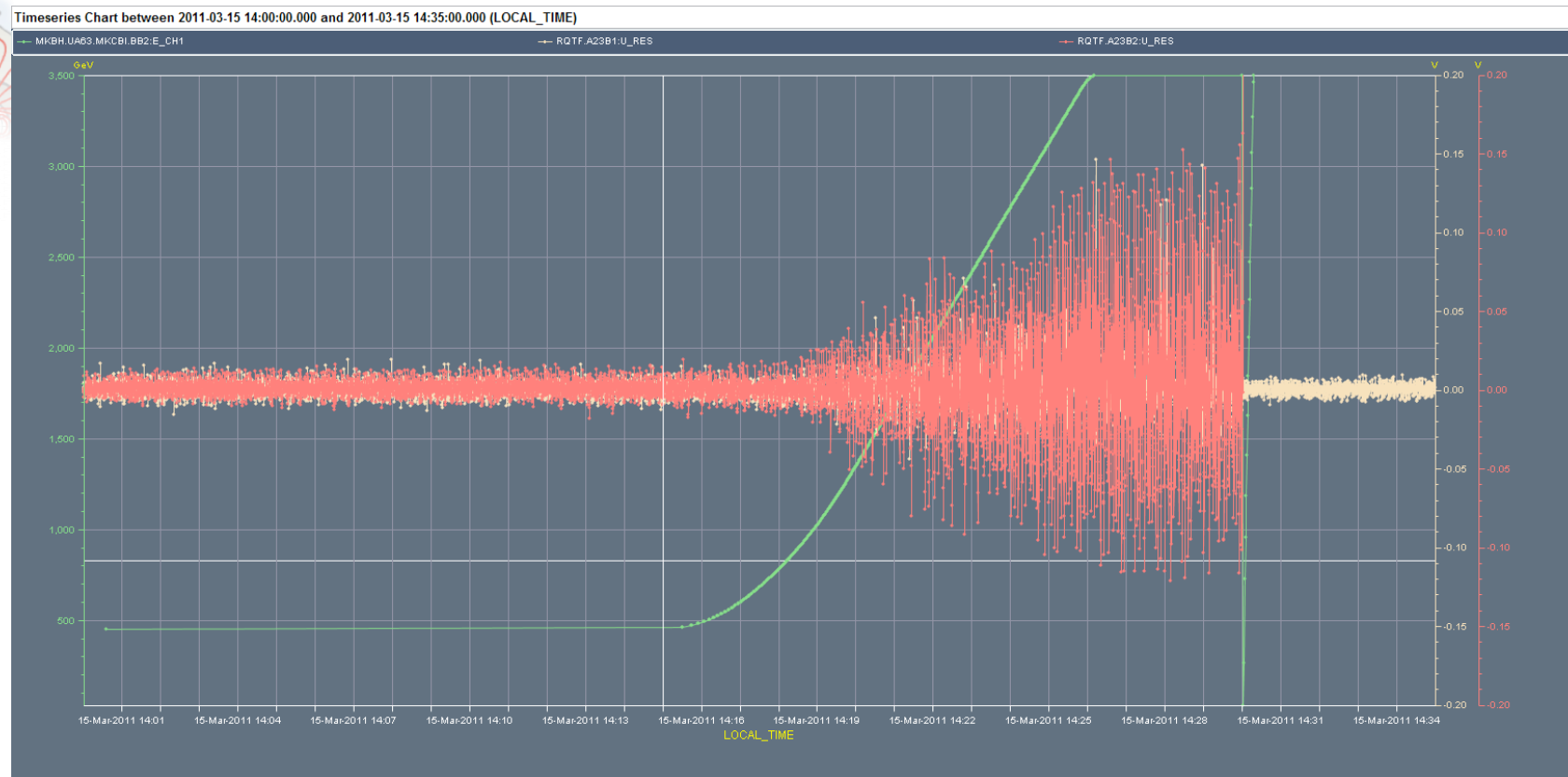
Main Problem:
beam 2, horizontal

8 bunches

At 3.5 TeV switch off ADT -> perturbing lines still too large relative to tune lines.

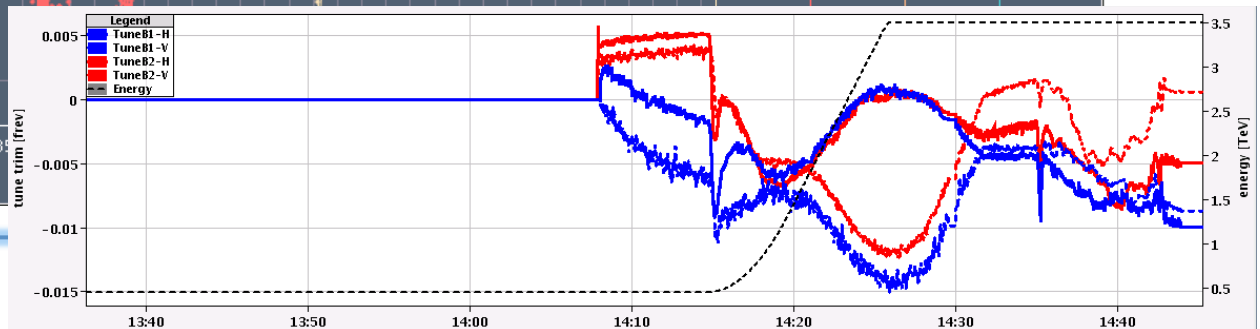
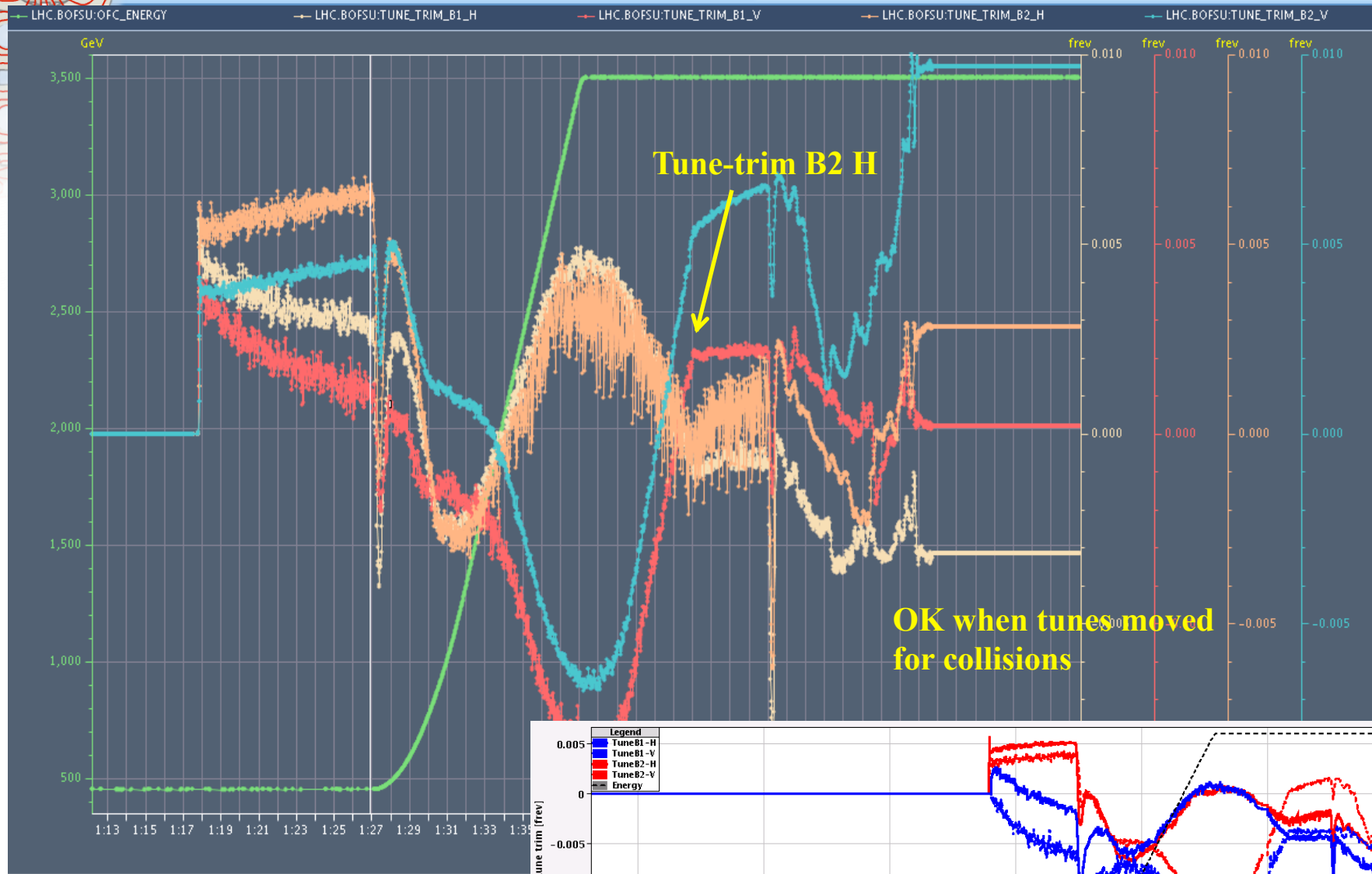
RQTF trip

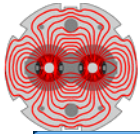
- U_res



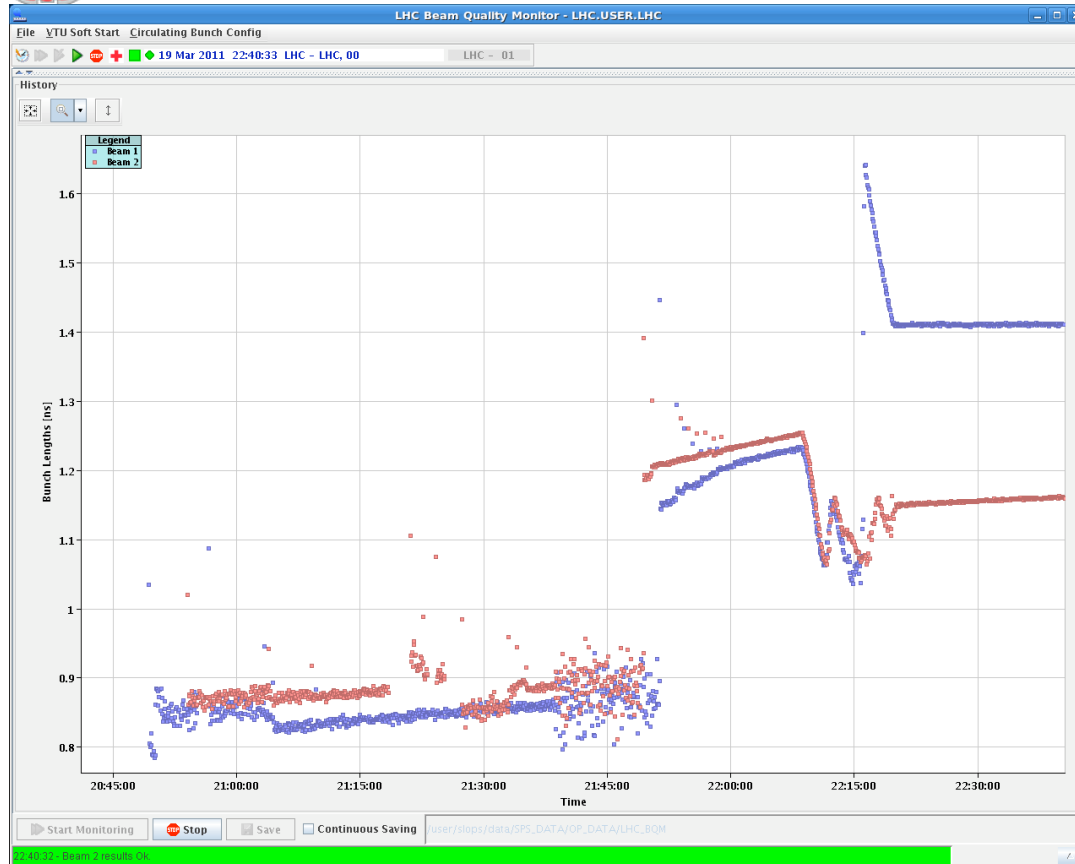
- Reduced gain of the transverse feedback all through the ramp

The 8 bunch ramp that stayed in - lucky



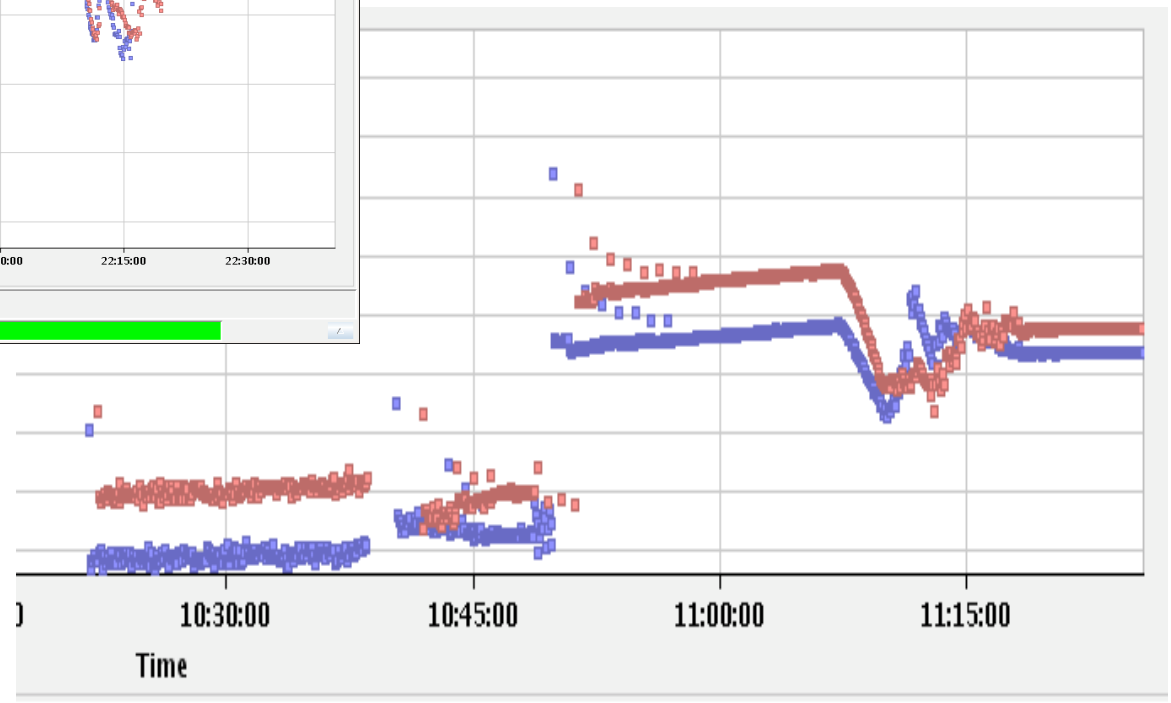


Long. Blow-up

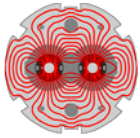


Longitudinal blow-up still requiring some tuning.

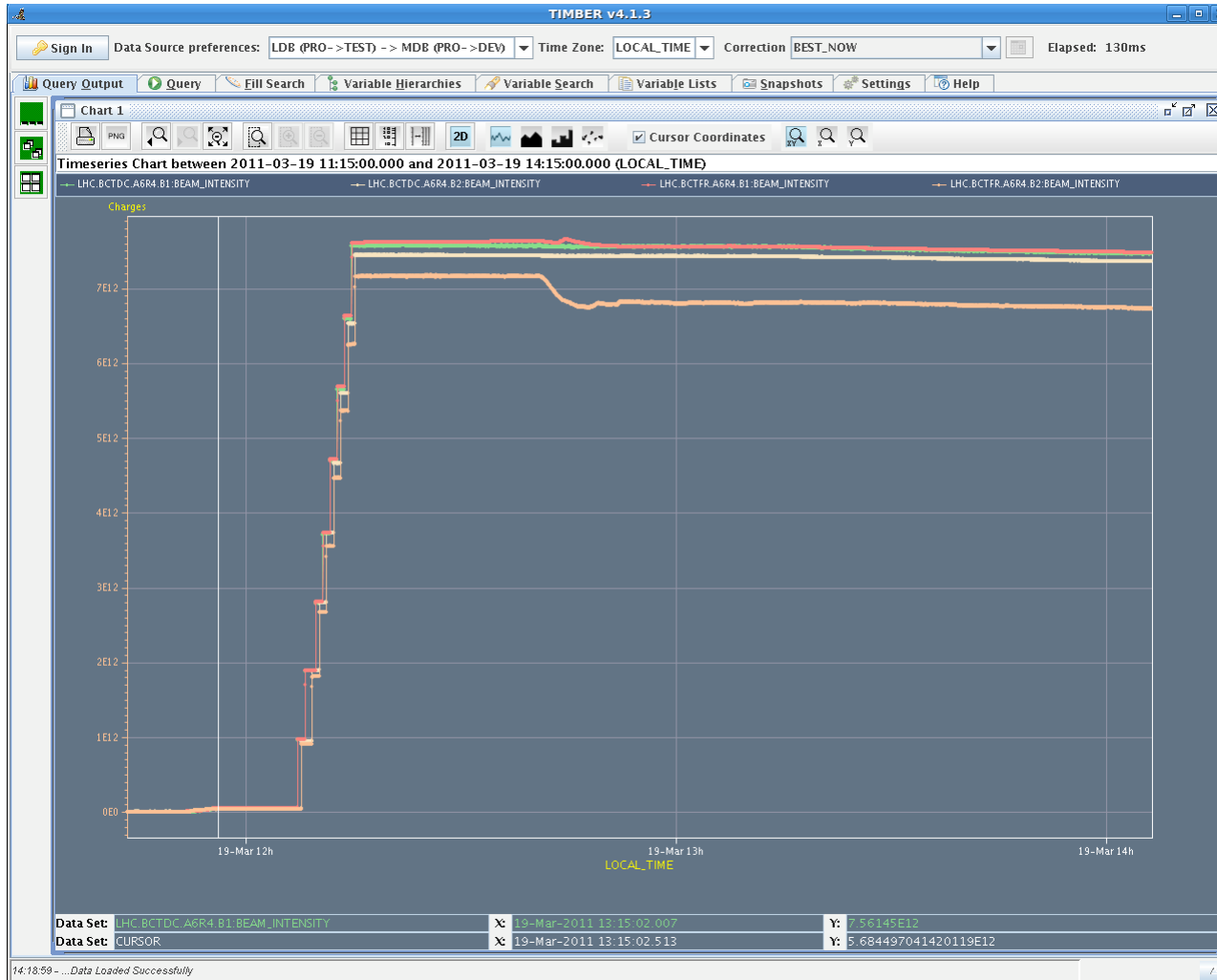
Too fast blow-up for beam 1



... done



DCBCT vs Fast BCT





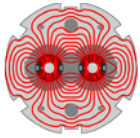
Test and Preparation for 1.38 TeV Run ...

- Prepare ramp and collision for 1.38 TeV operation
 - Found collisions in all IPs **except ALICE**

good news:

Alice is the only experiment that does not need 1.38 TeV collisions

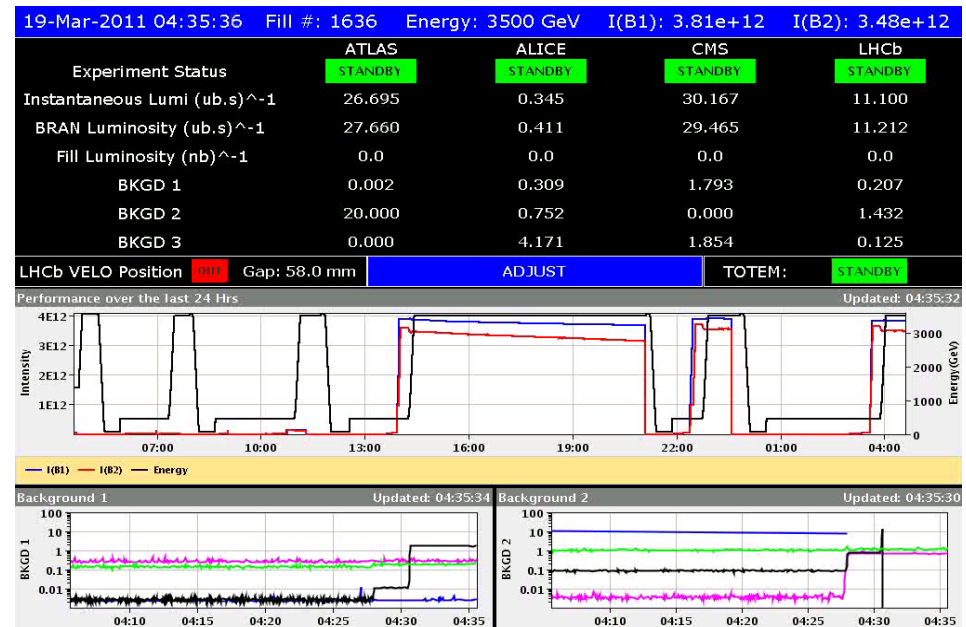
! ? !

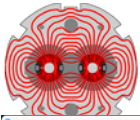


Friday 18/03: Luminosity Run 32 x 32

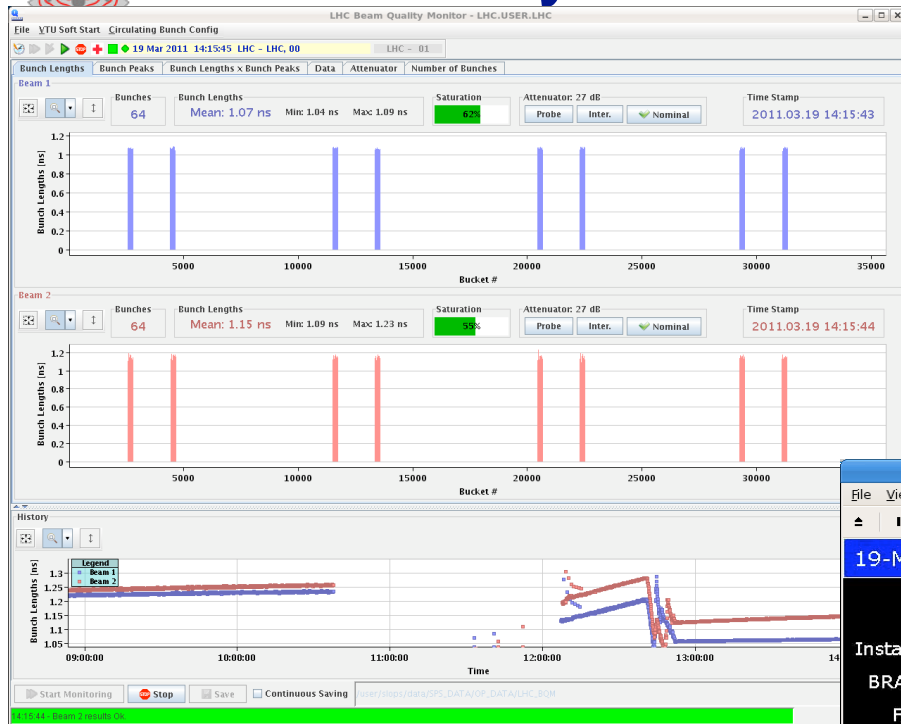
- 07:15 Test ramp with pilot after the test of dynamic FIDEL correction.
 - Ramp was OK, but fill was stopped due to **the trip of several RQTFs** when switching on the radial modulation for chroma measurement with tune feedback on
- 09:00 New version of the timing deployed but several problems
 - Revert to the previous version on system B and
- 10:45 Performed another test ramp with one nominal bunch.
 - At the beginning of the squeeze, the **tune feedback tripped a bunch of RQT**
 - Reverted yesterday's BBQ acquisition change from 5 back to 2.5 Hz
- 14:10 Ramped 32 nominal bunches, squeeze and collisions without trouble
 - Tune feedback on, also at beginning of the squeeze
- 15:05 Stable Beams!

third fill with 32 bunches





Luminosity Run 64 x 64 bunches



VLC media player

19-Mar-2011 13:23:17 Fill #: 1637 Energy: 3500 GeV I(B1): 7.54e+12 I(B2): 6.80e+12

| Experiment Status | ATLAS | ALICE | CMS | LHCb |
|---|--------|-------|--------|--------|
| Instantaneous Lumi (ub.s) ⁻¹ | 61.922 | 0.623 | 66.051 | 25.888 |
| BRAN Luminosity (ub.s) ⁻¹ | 63.077 | 0.692 | 66.380 | 24.391 |
| Fill Luminosity (nb) ⁻¹ | 0.0 | 0.1 | 17.0 | 6.6 |
| BKGD 1 | 0.003 | 0.293 | 3.790 | 0.272 |
| BKGD 2 | 34.000 | 1.199 | 0.000 | 1.431 |
| BKGD 3 | 16.000 | 4.781 | 1.854 | 0.157 |

LHCb VELO Position Gap: 20.0 mm STABLE BEAMS TOTEM: STANDBY

Performance over the last 24 Hrs Updated: 13:23:10

Background 1 Updated: 13:23:15

Background 2 Updated: 13:23:16

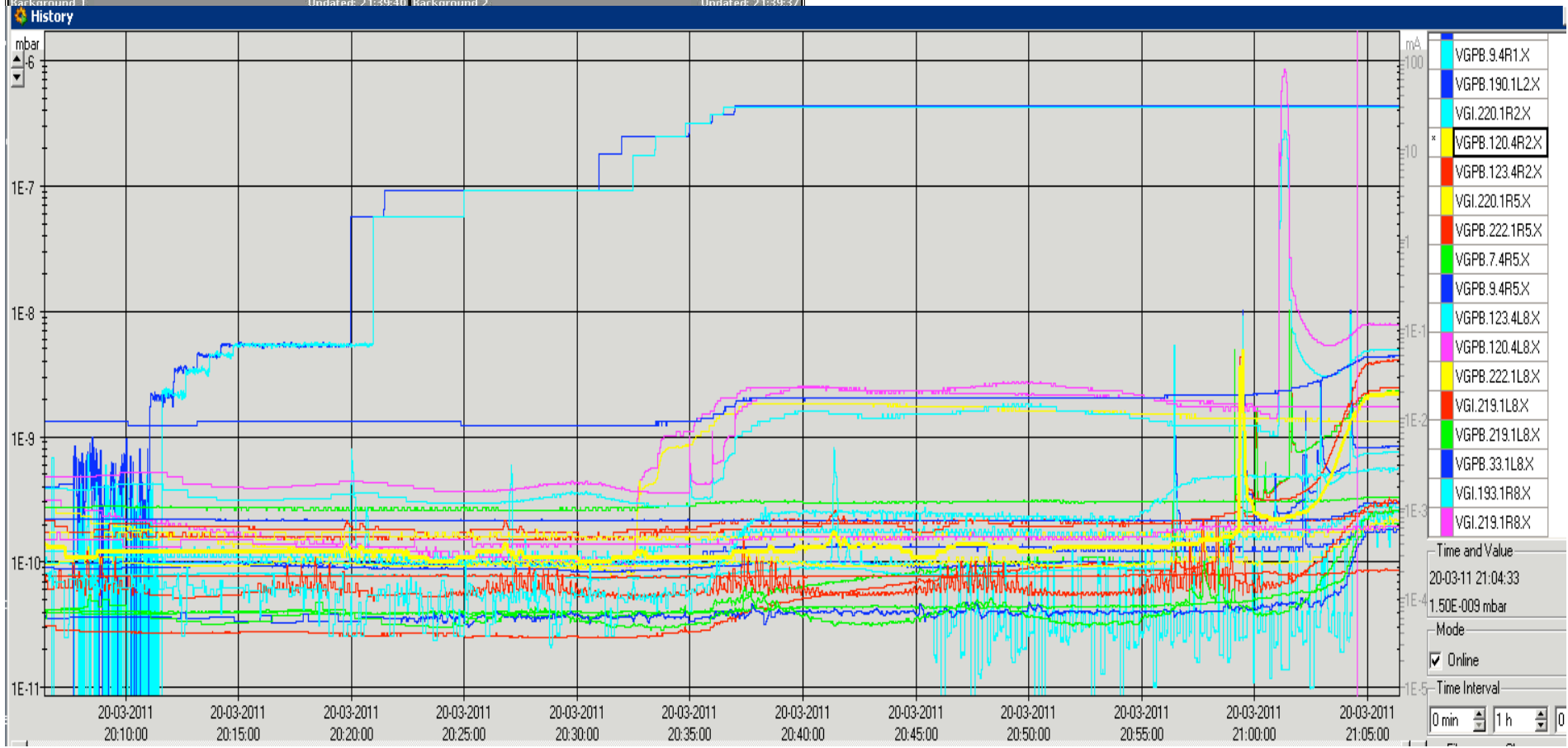
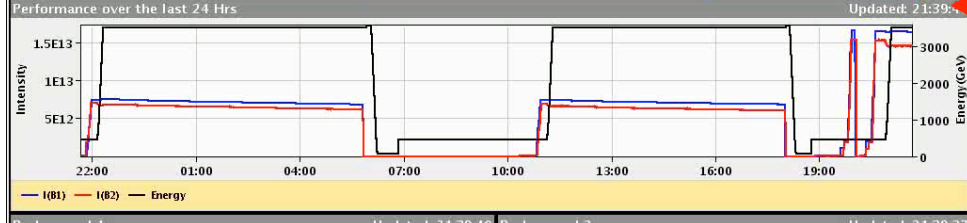
0:00:00 / 0:00: x1.00 "LHC Operation"

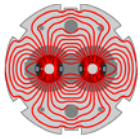
136 Bunch Operation

| Experiment Status | ATLAS | ALICE | CMS | LHCb |
|---|----------|-------|---------|--------|
| Instantaneous Lumi (ub.s) ⁻¹ | 145.268 | 1.247 | 148.656 | 43.655 |
| BRAN Luminosity (ub.s) ⁻¹ | 144.407 | 1.154 | 146.206 | 45.331 |
| Fill Luminosity (nb) ⁻¹ | 0.0 | 0.5 | 70.7 | 21.0 |
| BKGD 1 | 0.004 | 0.293 | 8.016 | 0.329 |
| BKGD 2 | 2679.000 | 2.075 | 0.000 | 1.749 |
| BKGD 3 | 16.000 | 5.646 | 0.488 | 0.254 |

LHCb VELO Position ON Gap: -0.0 mm STABLE BEAMS TOTEM: STANDBY

... remember the two good news ??





136 Bunches ... Frank ?????



(Technical) Problems:

*Spontaneous dump from the TCTH.4L5.B1 due to fake alarm:
"Position out of limits" but the position sensors remained well within
the limits*

Tune Feedback - noisy tune spectrum

*trip of RQDT Quadrupoles
feed back gain reduced*

BCT ... discrepancies

timing distribution: ... still problems with soft ware

"Bug in the Timing Receiver Cards (CTR) firmware"

75 ns trains – "there are clouds in my coffee"

The good news:

Collisions 136 x 136 established,

Procedures stable, Operation reproducible

*Tune Feedback - **noisy tune spectrum** overcome at the moment
feed back gain reduced*

1.38 TeV prepared

