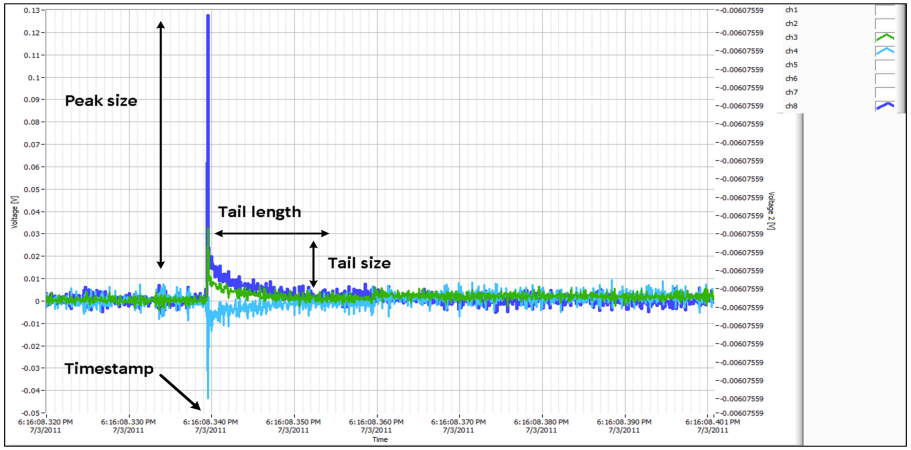
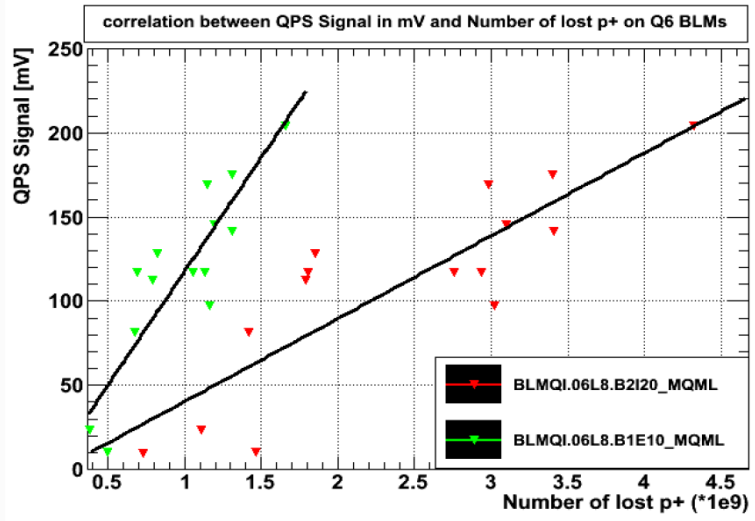
Quench Margin at Injection

ABT/BTP, OP, Collimation, BLM, QPS teams

Results from last MD

• Injecting pilot bunch with increasing intensity (1-3×10^{10} p+)on the TCLIB
• Monitoring losses at TCLIB and downstream magnets (MQ6.L8, MQ7.L8)
• Monitoring QPS at MQ6.L8

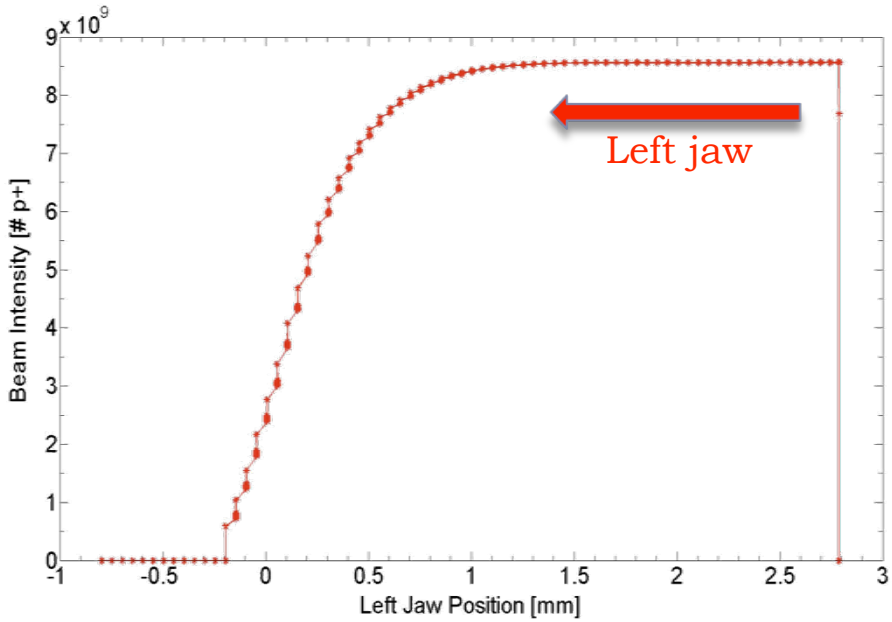


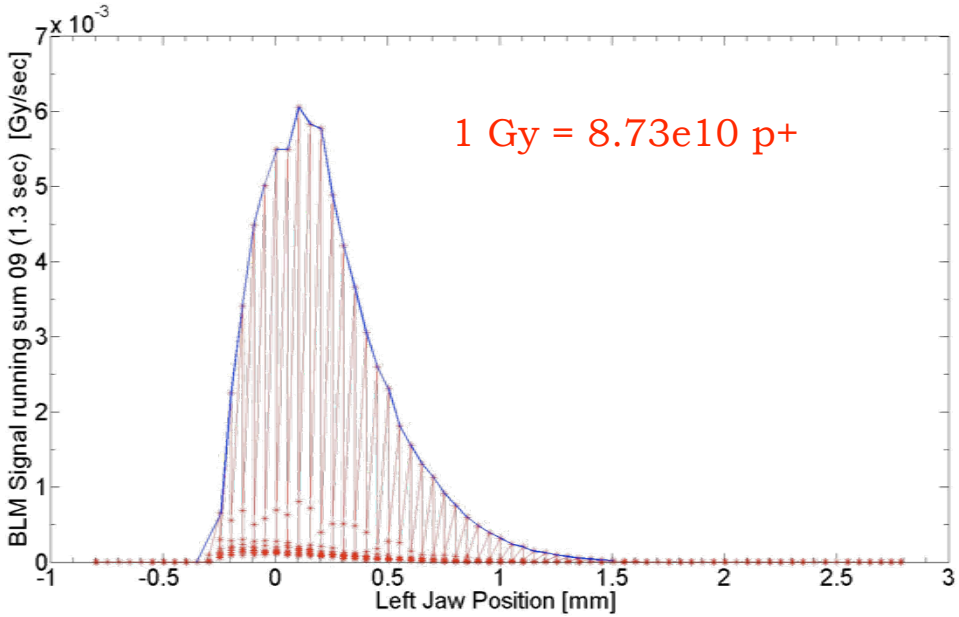


• We saw a signal at the QPS
• Signal was increasing with beam intensity: beginning of a **quench/ quenchino?**
• BLM at Q6 above quench threshold (×3 dump thresholds)
• BLM in saturation for all intensities ➔ need **calibration**

TCLIB BLM Calibration

- Slow full beam scraping: 50 μm steps every 10 s (90 steps in total) with a pilot bunch (~9×10^9 p+).

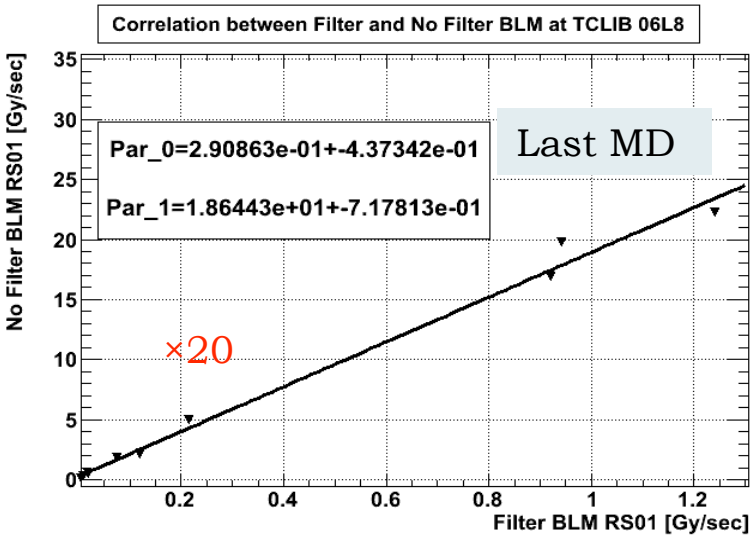


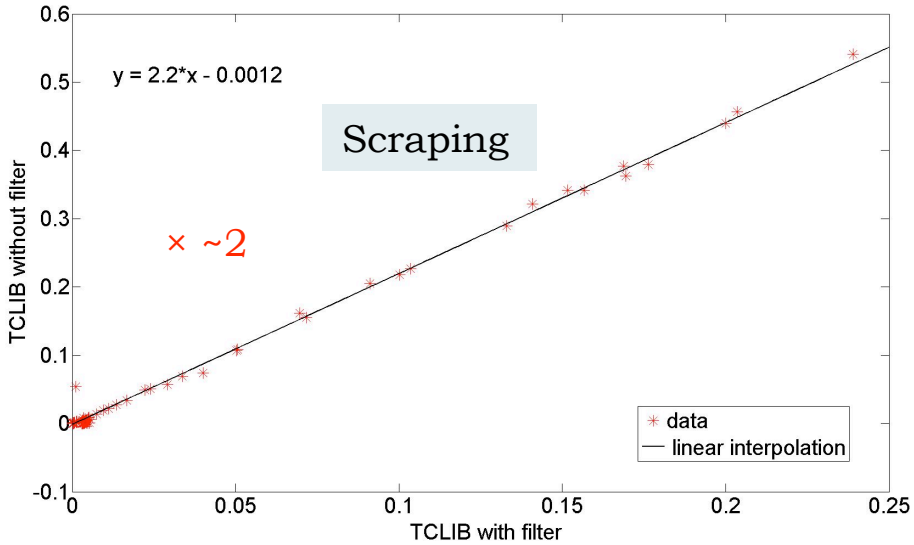


Input for FLUKA studies (normalization factor)

Other Observations

• At TCLIB a BLM monitor with RC filter has been installed. A factor 180 lower signal was expected at the filtered monitor (running sum 01: 40 μs) but:

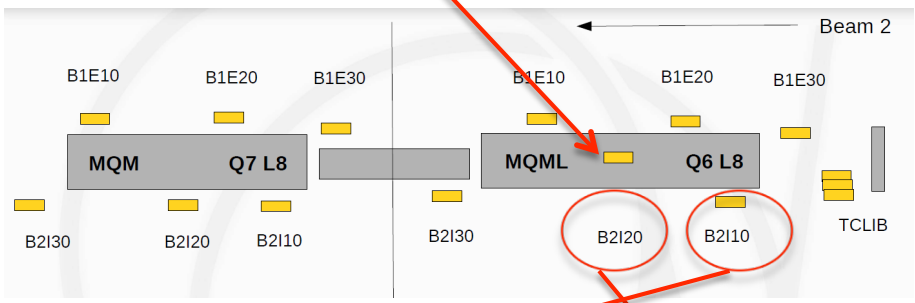


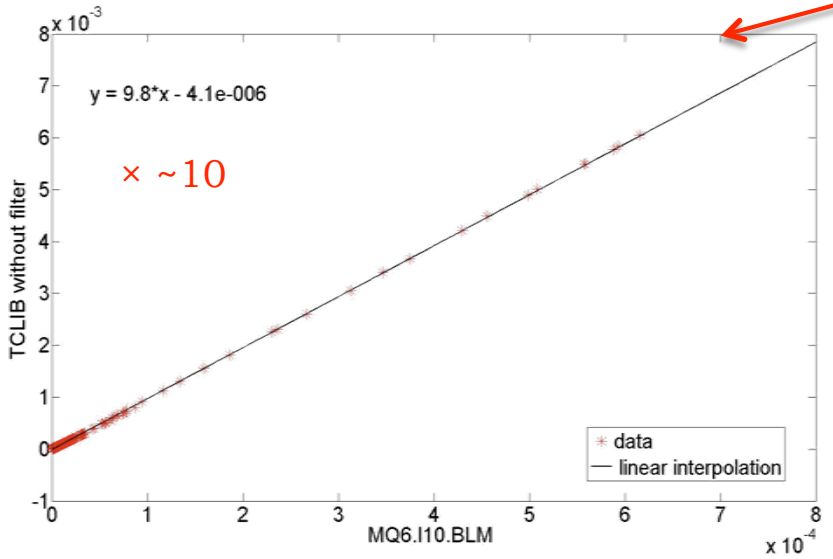


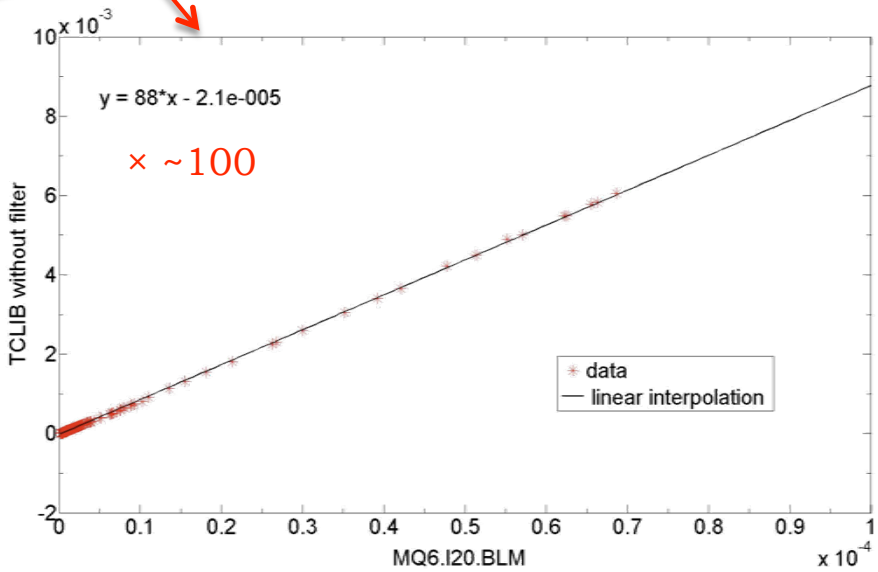
To be investigated !!!

Other Observations

• Estimated leakage from TCLIB to MQ6 (last MD data analysis, reconstruction from B2 BLM due to saturation): 10-20%

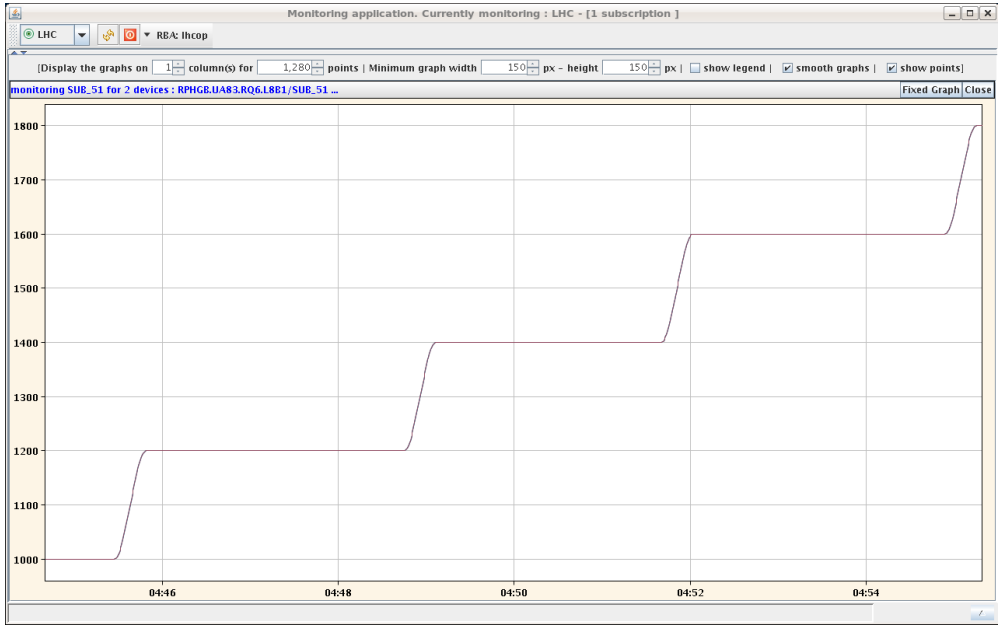






New MD: Increase MQ6 Current

- Closed TCLIB collimator to 1 mm gap and -3 sigma offset
- Beam 2 inject and dump, pilot bunch of 3e10 p+
- BLM monitors at TCLIB and Q6 in saturation (> 1000% ratio to dump)
- We increased the current of Q6.L8 magnet in steps of 200 A until 2200 A (5 TeV operation) and recorded QPS signal
- QPS didn't show any significant variation when increasing the beam current ➔ NO QUENCH or QUENCHINO recorded.



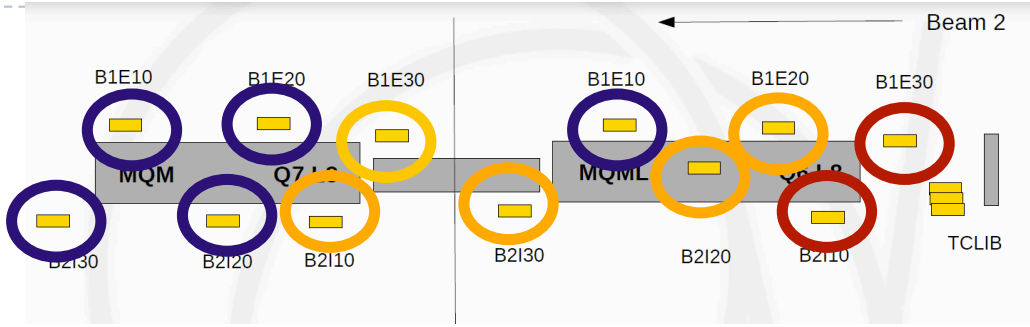
Signal induced by showers on the electronics?
TCLIB intercepts the full beam ➔ too diluted energy deposition at Q6 to cause a quench.

• Higher BLM thresholds?
• TCLIB back to nominal aperture (6.8 σ, now 8.3 σ) ?

Need results from FLUKA simulations

Measured signals in BLMs

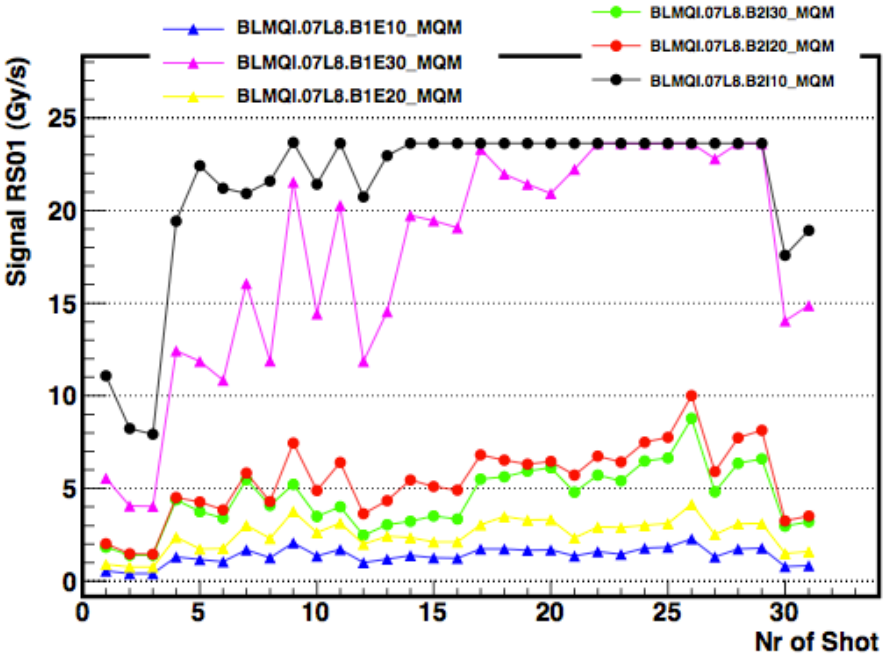
Eduardo Nebot Del Busto

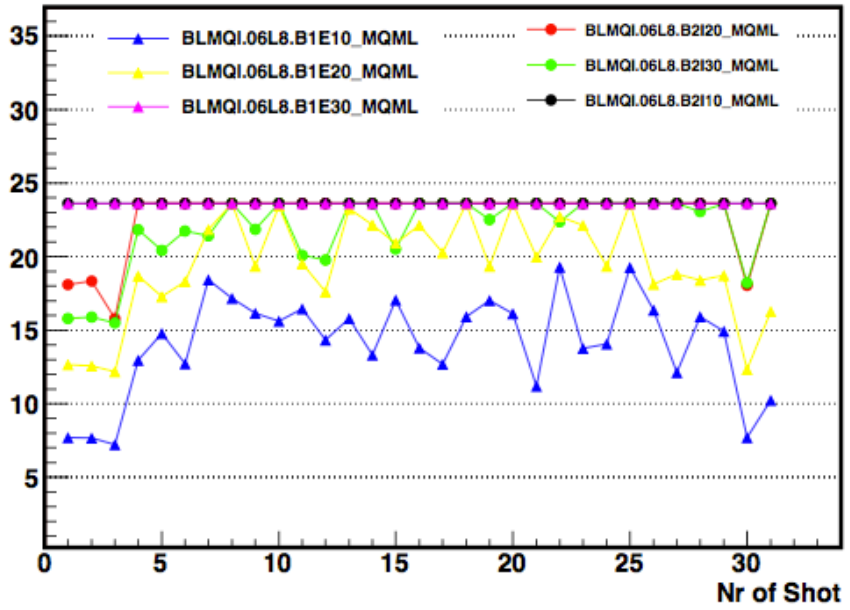


Two monitors in Q6 continuously in saturation.

Four monitors in Q7 and 1 monitor in Q6 never reach saturation.

Three monitors in Q6 and two monitors in Q7 eventually reach saturation. When saturated, the signals of these monitors can be reconstructed from reconstructed via B1E10.



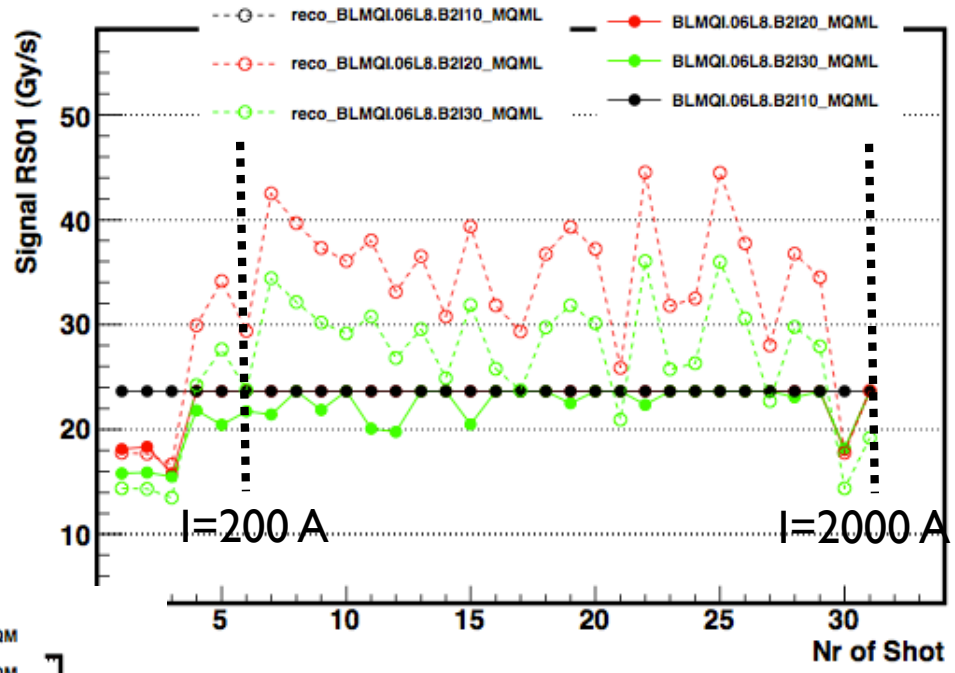


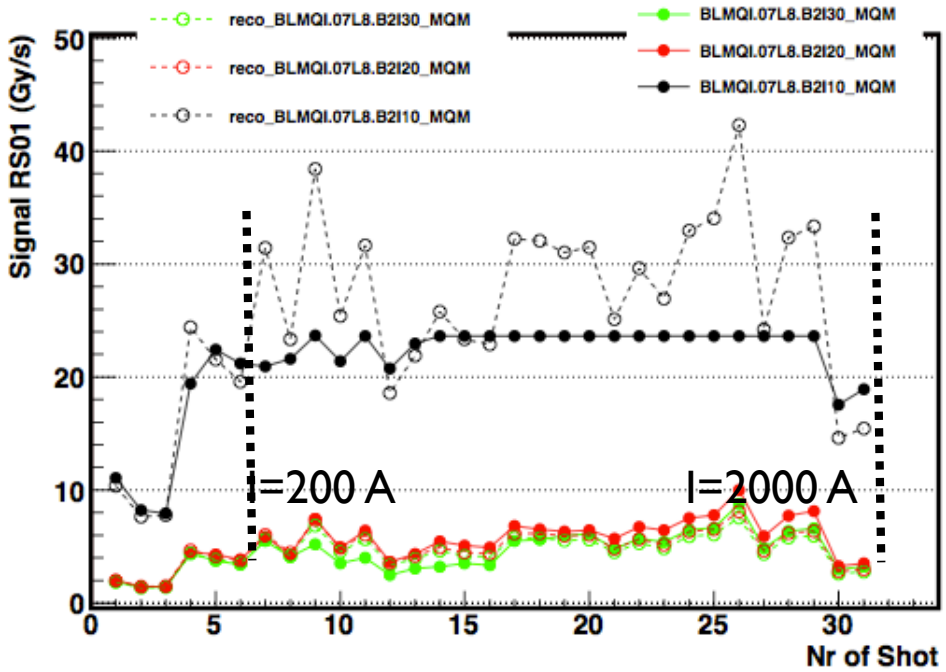
Reconstructed signals in BLMs

Eduardo Nebot Del Busto

Q6

For BLMQI.06L8.B2I20_MQML the Quench level is estimated in 5.8 Gy/s at 450 GeV and 0.46 Gy/s at 5 TeV (2000A). The reconstructed signal exceeds the Quench level by a factor ~8 (~40) at 450GeV (at 5TeV).





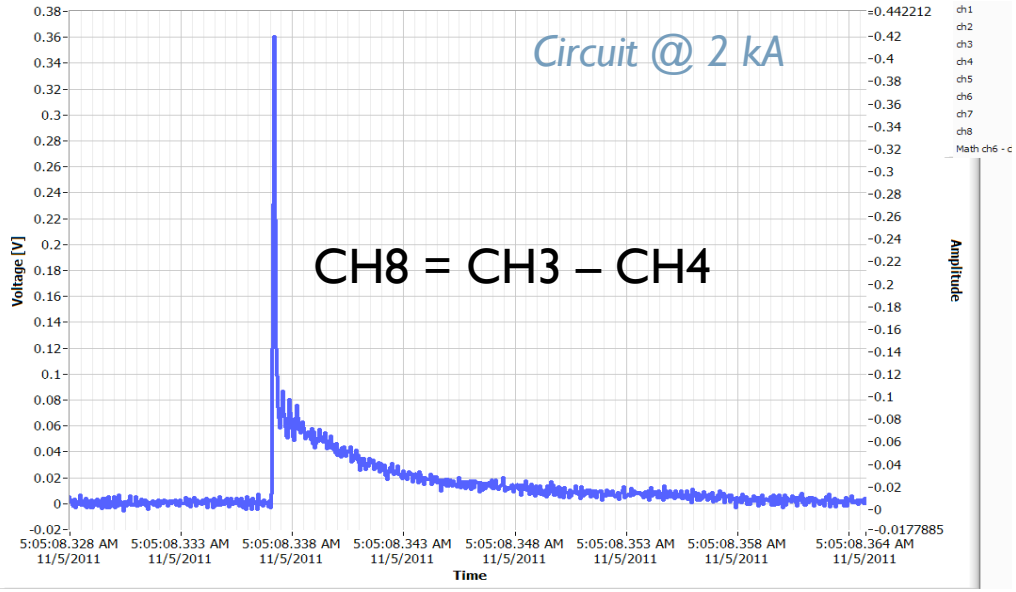
Q7

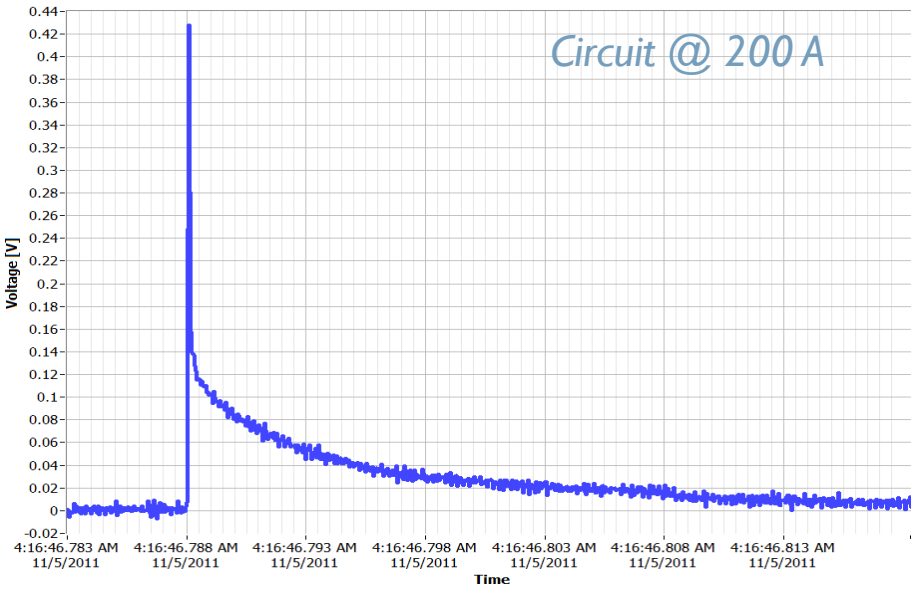
For BLMQI.07L8.B2I10_MQML the Quench level is estimated in 51.8 Gy/s at 450 GeV and 3.04 Gy/s at 5 TeV (2000A). The reconstructed signal exceeds the Quench level at 5TeV by a factor ~5 but it does not reach it at 450 GeV.

QPS Signal

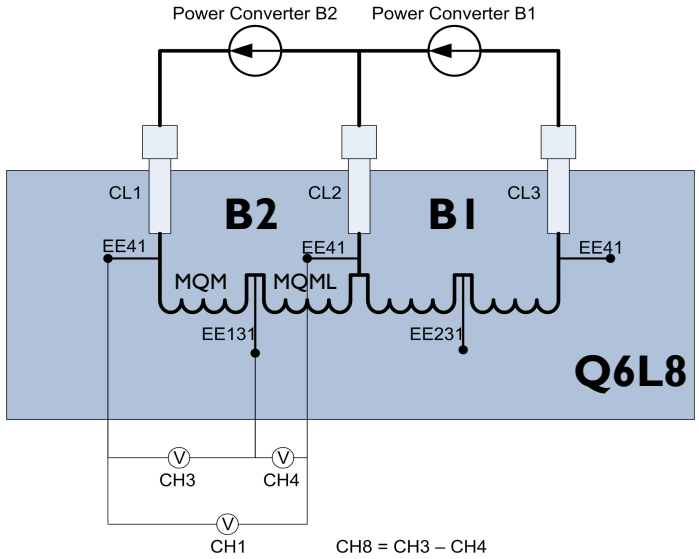
Mateusz Jakub Bednarek

Signals sampled at 10kS/s

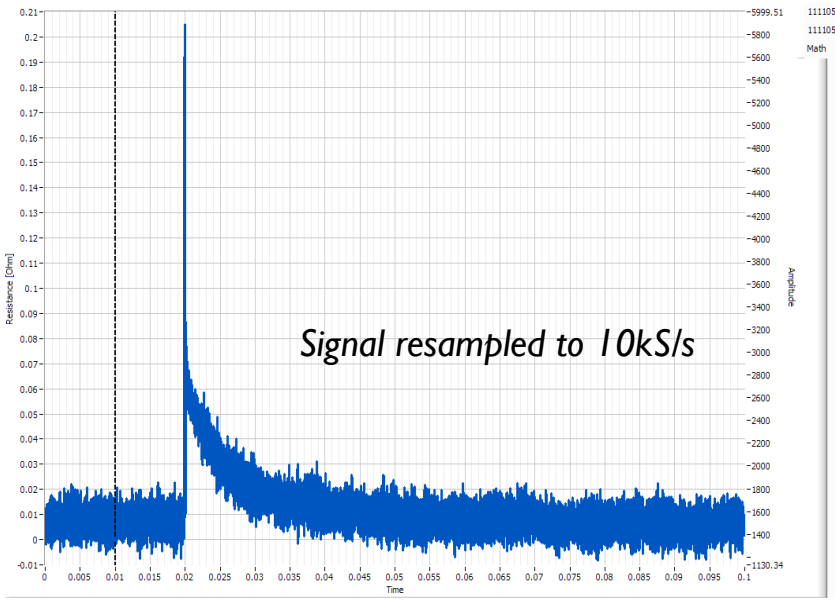


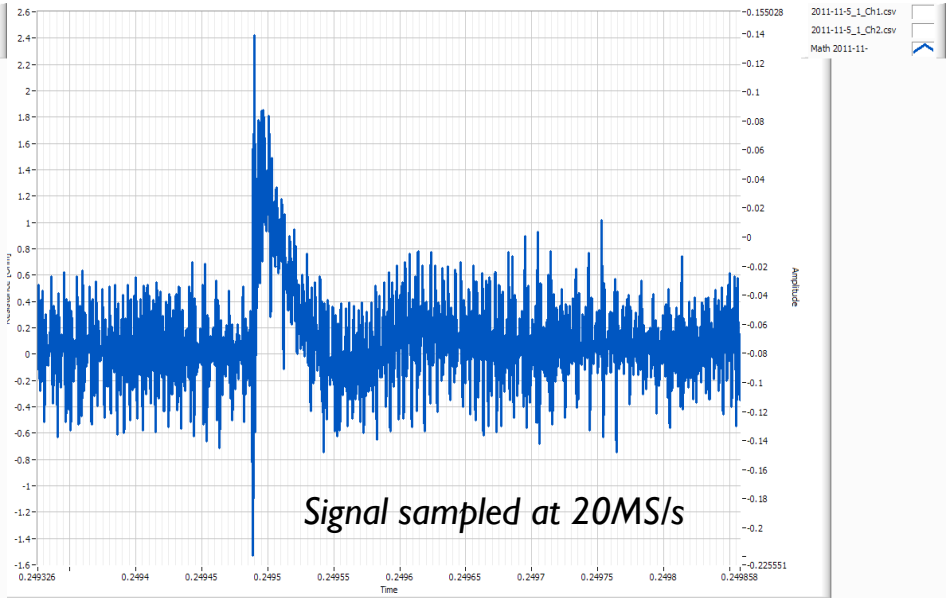


CH8 corresponds to the signal seen by the quench detector (all the inductive voltages are cancelled, only the resistive signal is seen, unless…
Unless there are some signals on EE131 which could be seen as well: electronic artifact



QPS Signal, Fast Acquisition





- A fast acquisition system was used as well
- More sampling frequency => more noise
- By averaging samples to the frequency of the other system we reproduce exactly the same signal
  - No electronic artefact

Analysis on going.....

Mateusz Jakub Bednarek

Injection of 25 ns beams – floating MD

Injection team, ABT, ABP ecloud team, RF and ADT teams, OP, …

MD plan (for reference)

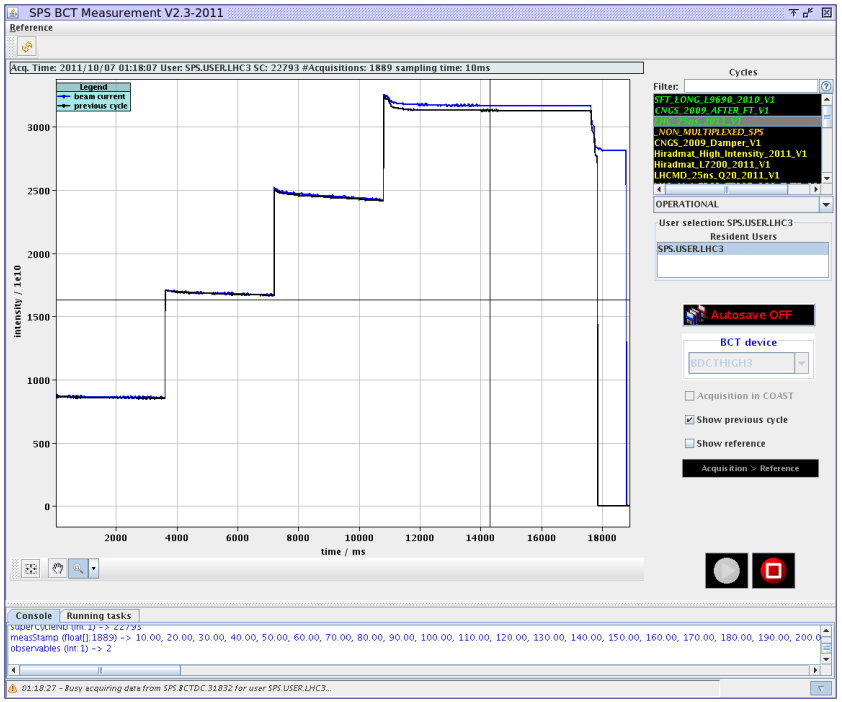
** RF checks (1-2h)

** Damper setup (4-5h)

** Increasing injected intensity (4h)

Beam in the SPS:

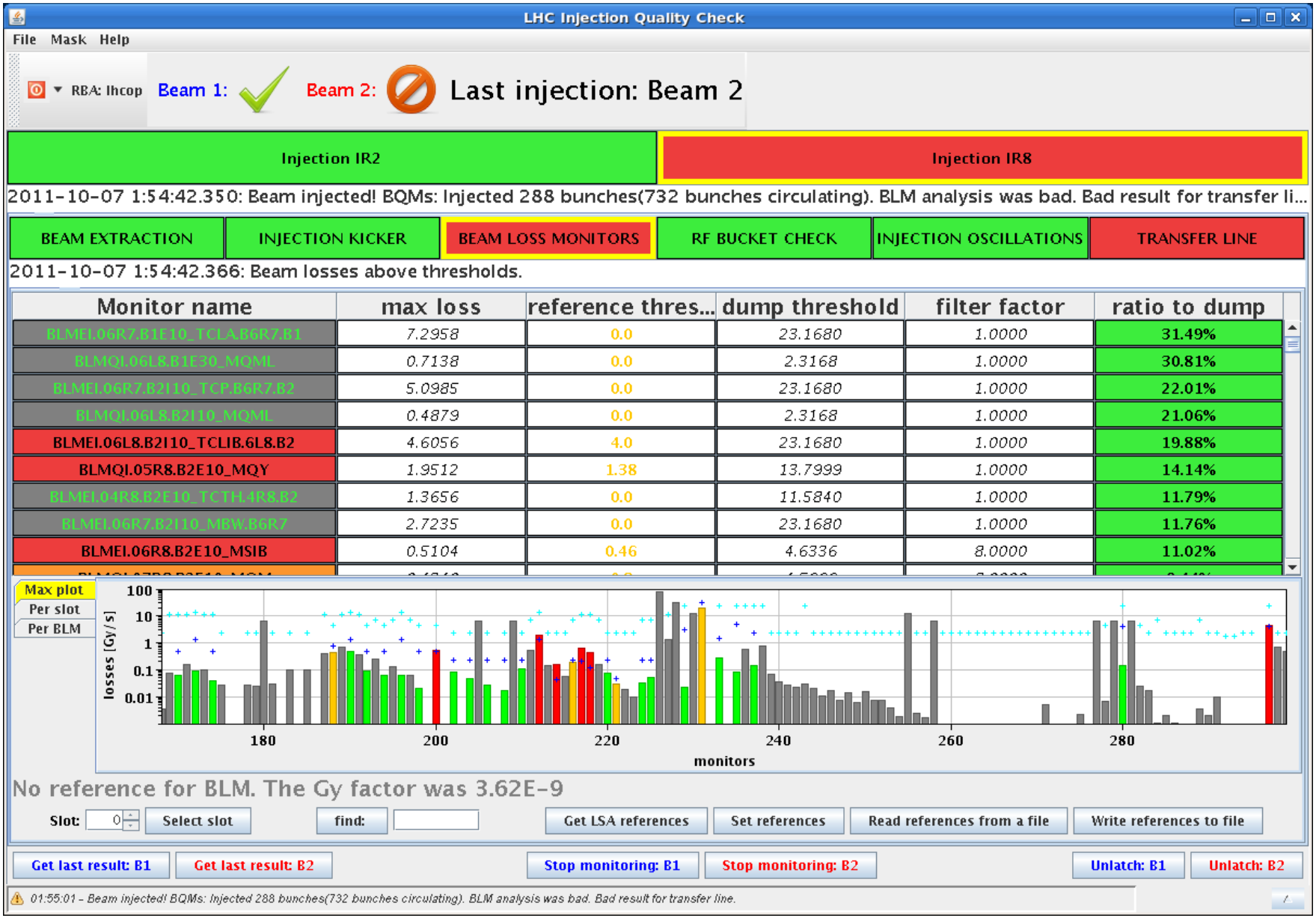
- 1.05e11 per bunch
- 2.5-2.7 μm transverse emittance
- Well scraped (>10%)



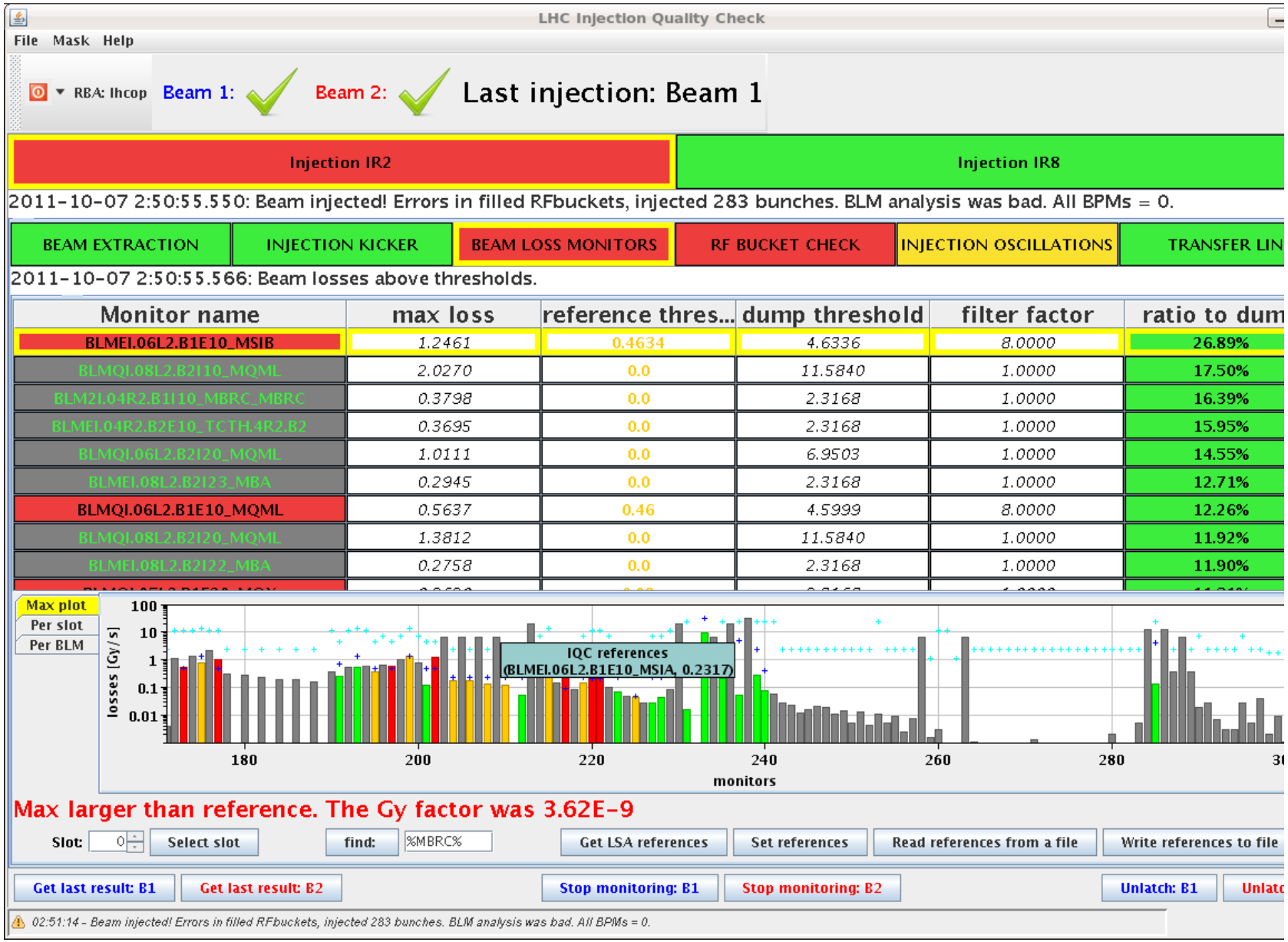
Chromaticity

- For 48b trains, bunches lost very quickly at end of trains
  - Dumped on losses after 1500 turns
  - Fast instability with <100 turns rise time
- Chromaticty increased by +20 units both beams, both planes
- Beams then kept for 48, 72 and 144b
  - Lifetimes around 5 h after some initial cleaning
- 288b injection OK for both B1 and B2 – losses on TCTH.R2.B2 caused dump for B1
- Injected 3e13 (288 bunches of 1.05e11) – **2.2 MJ !!**

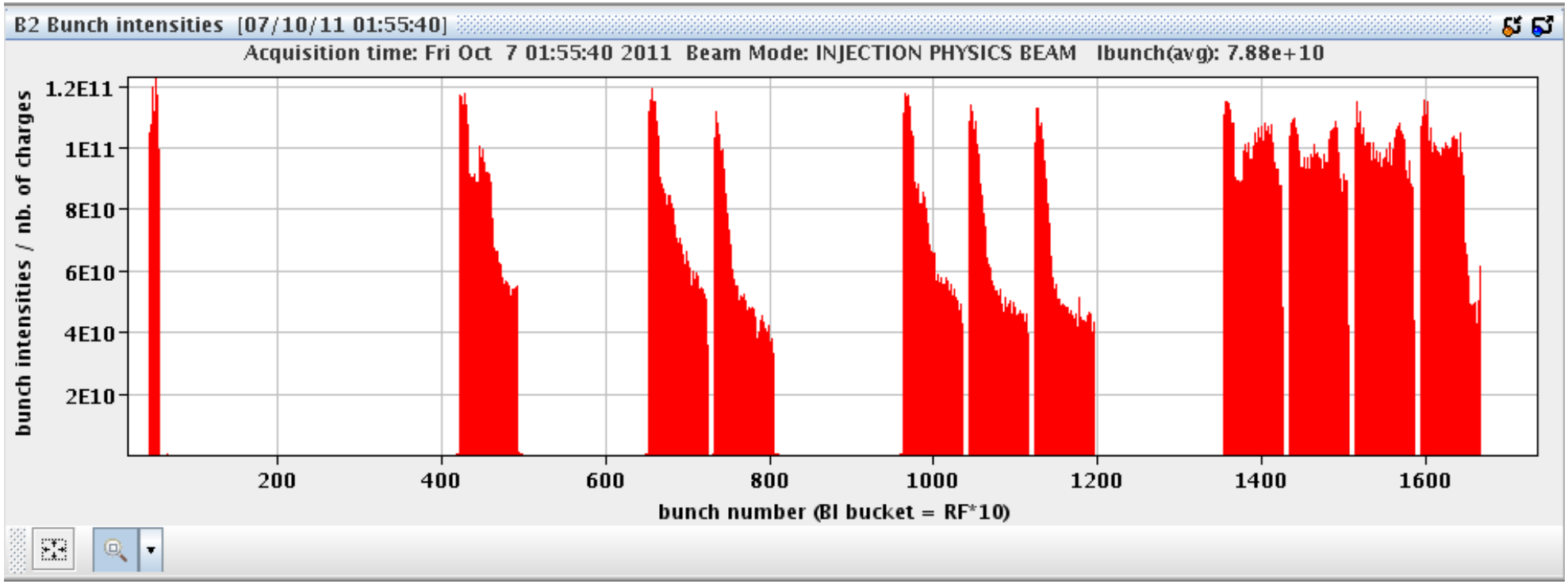
B2 288b injection – 30% of dump



B1 288b injection – 27% of dump



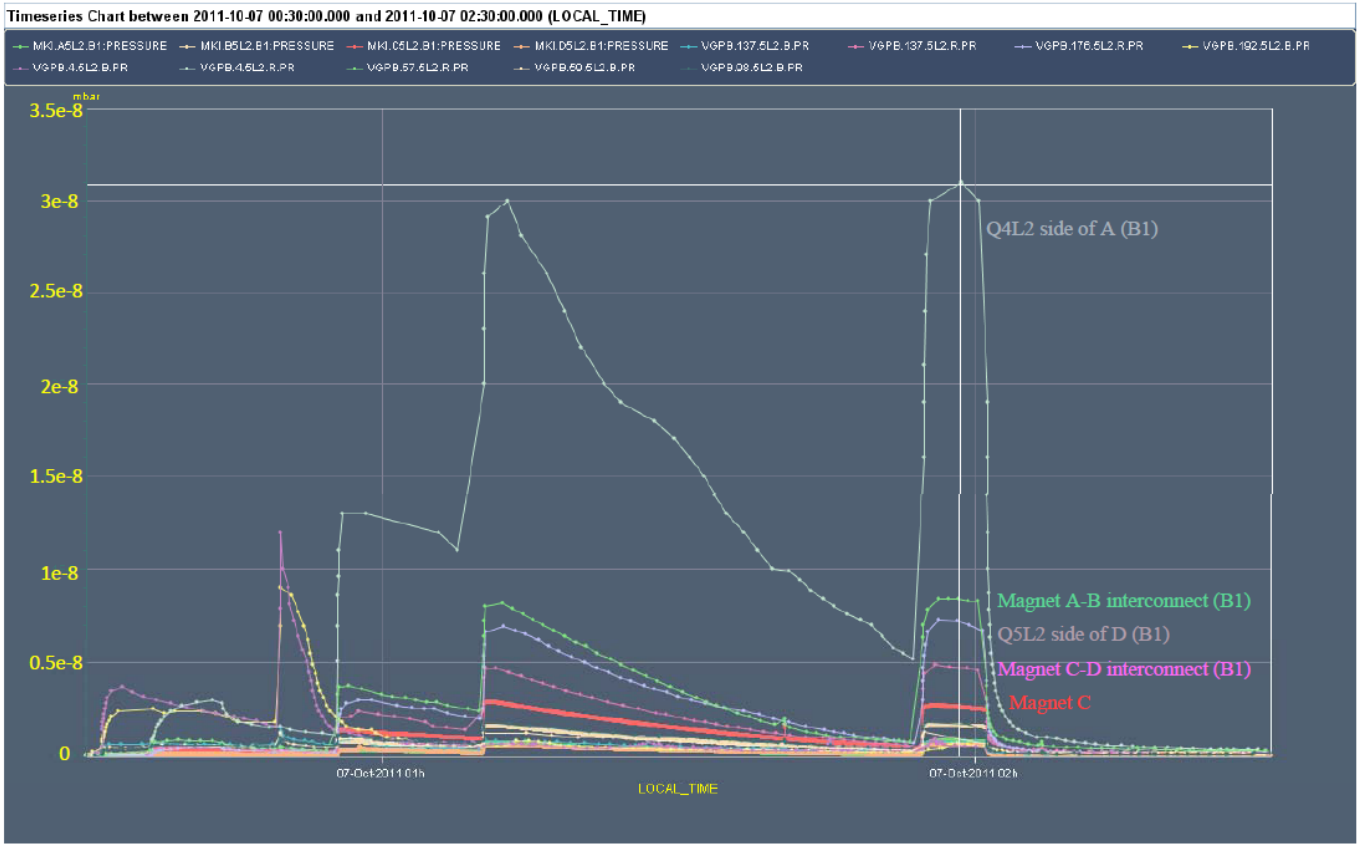
B2 accumulation of 732b



- Strong losses through batch for initial injections (72, 144b)
- Much better for 288b – better Q' setting of +17

Kicker pressure rises

- Factor 3 higher in P8 than P2 – but e-cloud solenoids there were OFF



MD Requests for 2012

2012 LHC MD

- Dedicated MDs
  - Transfer line stability
  - Beam losses at injection (288b injection, new BLM checks, …)
  - Protection from long devices (TCDQ/TCT checks)
  - Impedance of TCDQ and TDIs (inlc. bunch length dependence?)
  - Injection matching and emittance preservation
  - Q20 optics beam extraction, transfer and injection
  - UFOs at MKIs and MKQ
  - Quench limits at injection and dump protection elements
- Parasitic MDs
  - Beam induced heating of various elements (TDI, MKI, TCDQ)