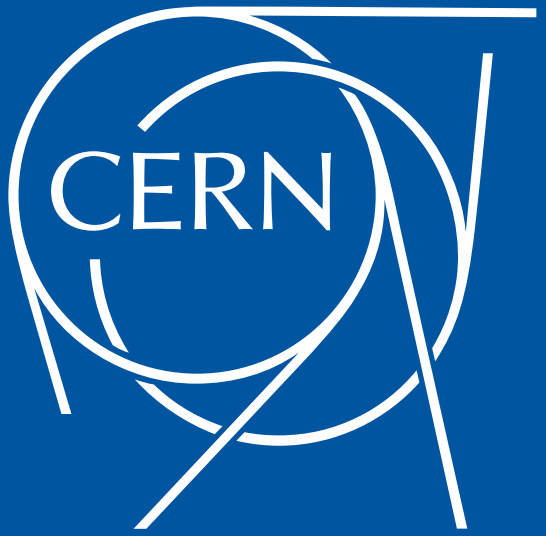
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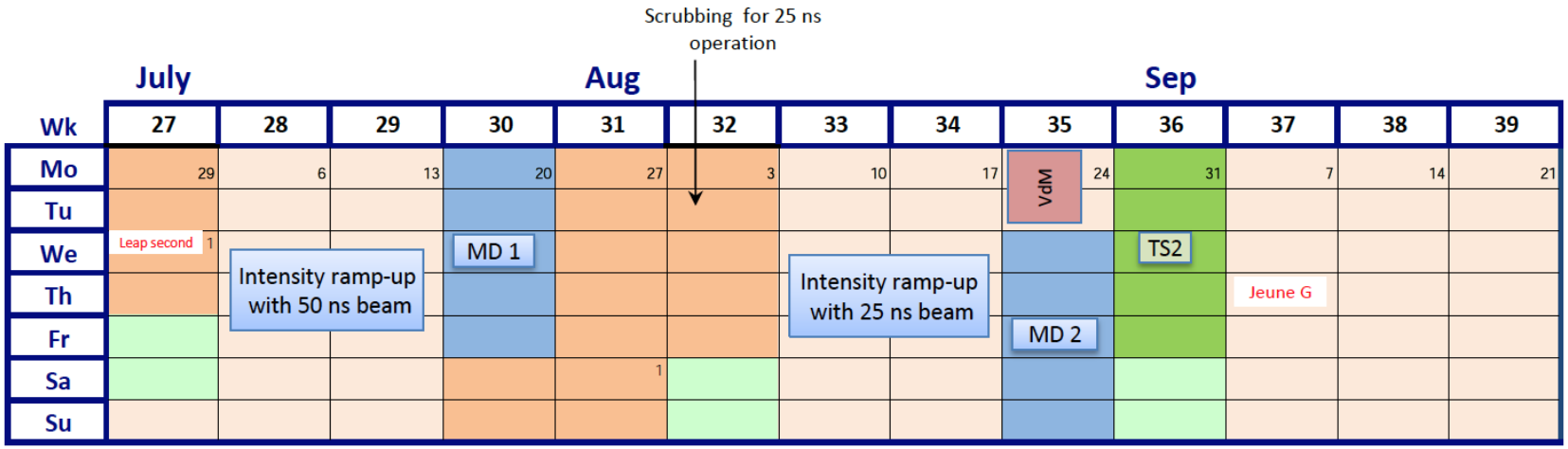
Issues during Intensity Ramp – Up
&
Proposal for restart after TS2

D. Wollmann, M. Zerlauth, R. Schmidt, J. Wenninger, et al

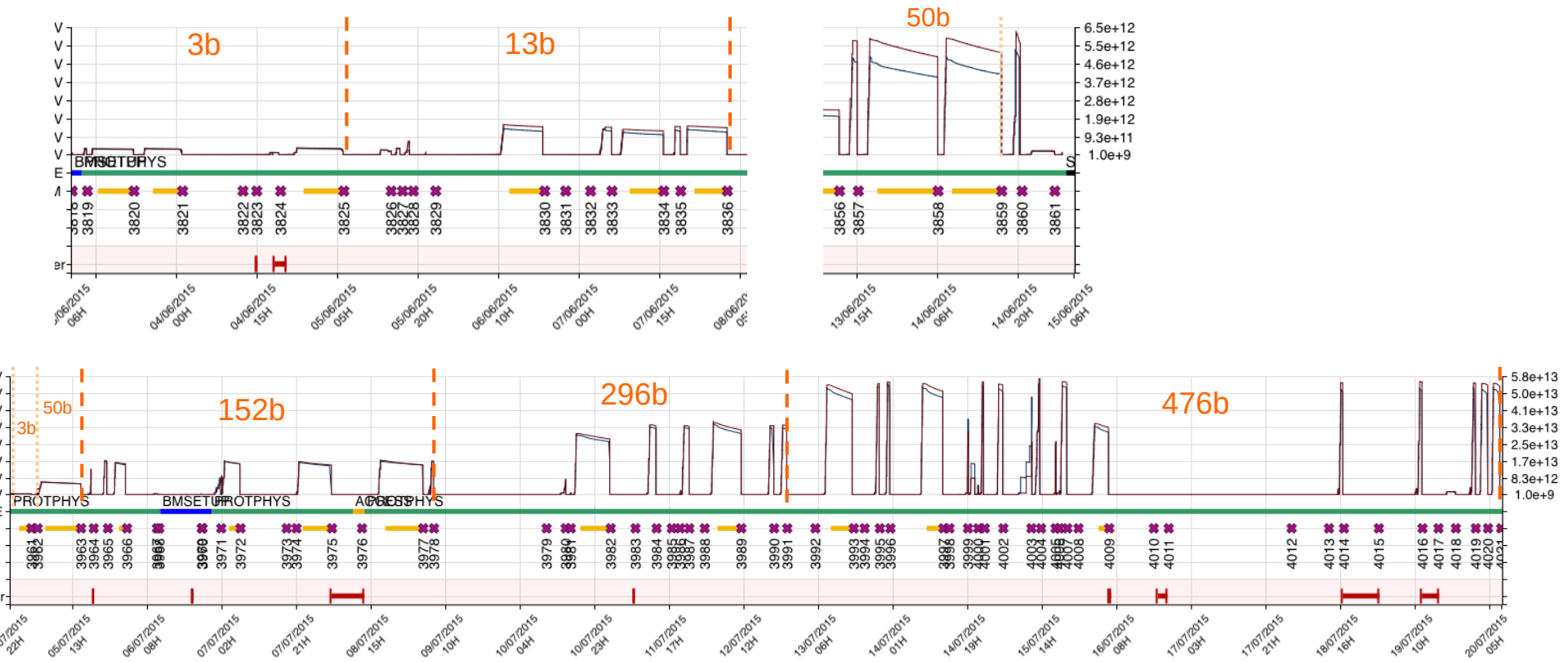
Acknowledgments go to all the system experts who faithfully filled the check lists.

Initial proposal for intensity ramp-up in 2015…

- 50ns (~9 steps to 1380b)
  - 3 – 12 – 48 – 144 – 288 - 480 –768 –1092 – 1236 – 1380
- 25ns (~11 steps to 2800b?!)
  - 3 – 12 - 48 – 72 - 144 – 288 – 432 - 588 –1164 –1740 – 2316 - 2748
- Updated – Proposal 25ns (MPP 04.08.)
  - 3 – 72 - 144 – 288 – 432 - 588 –1164 –1740 – 2316 – 2748
- Scrubbing run(s)
  - 3 – 48 – 72 - 144 – 288 – 400 – 600 – 800 – 1000,..



50ns Intensity ramp-up - Steps

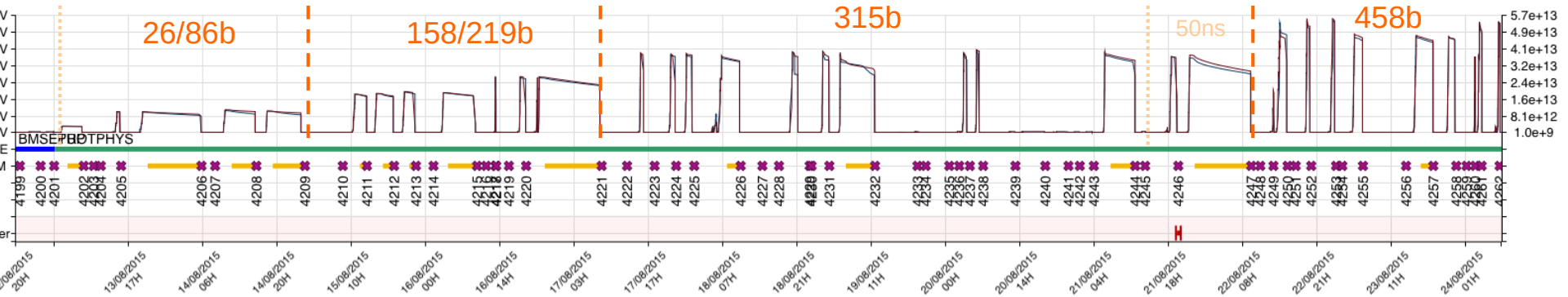


- 6 intensity steps → 6 check-lists

50ns Intensity ramp-up - Issues

- **Magnet Powering**
  - SEUs in QPS board for splice protection → trips of RBs sectors OR partial trip of sector by PIC due to intermittent opening of quench loop → beams dumped but RBs staid powered → **Replacement of boards** in TS2 AND activation of opening **13kA EE switches via SIS**.
  - QPS_OK flickering → **signal masked**
  - Transient earth fault in RB.A78
  - Earth fault in RCS.A78.B2 → **circuit condemned**
- **Interlocks and PM**
  - **BIS: timing mis-alignment** between LHC and INJ BIC → done
  - **Communication** problems between **BLM crates and SIS** (due to Ufo study buffer) → mitigated via **FESA class update**
  - UFO dumps → intensity dependent
- **RF**
  - Problems with phase loop caused beam to de-bunch → dump due to losses.
- **Beam Instrumentation**
  - **Glitches of SBF** due to noise on one B2 DCCT → solved
  - **BLM PM data missing** for R2, R3, and in IP6 → one fill with lower intensity. → solved via roll-back → **PM data collection module** being extended to check data collection and **send automatic emails**.
- **Collimation**
  - Spurious **ALFA dump due to glitch of position** measurement (LVDT) → solution implemented, to be re-**discussed in next MPP**.
  - **Resolver disabled** in TCTPH.4R2.B2, TCSG.A4L7.B2 → replaced?
  - LVDT drifts on some collimators (~50um)
  - Temperature sensor disabled on TCTPV.4R8.B2
- **Operation and Feedbacks**
  - Problems with **QFB (50Hz lines)** → filter reviewed → solved
  - **Orbit drifts** due to movement of triplet R8 → effect mitigated by slow orbit feedback in collision
- **LBDS**
  - Asynchronous beam dump (MKD erratic B2, generator C) → generator exchanged
  - BPMS software issues (FESA) prohibited to change interlock limits → solved
  - XPOC: PM BLM data missing; TSU data arriving too late → solved
- **Injection**
  - **Missing BPM capture data of injection oscillations** → improved but still issues visible → strategy to be discussed in next MPP
- **Heating of Equipment**
  - Decrease of bunch length at flat top
  - **TDI B2 temperatures increase steadily** during the fill
  - **TCSP.A4R6.B1 shows a different thermal dynamics** than all other collimators

25ns Intensity ramp-up - Steps



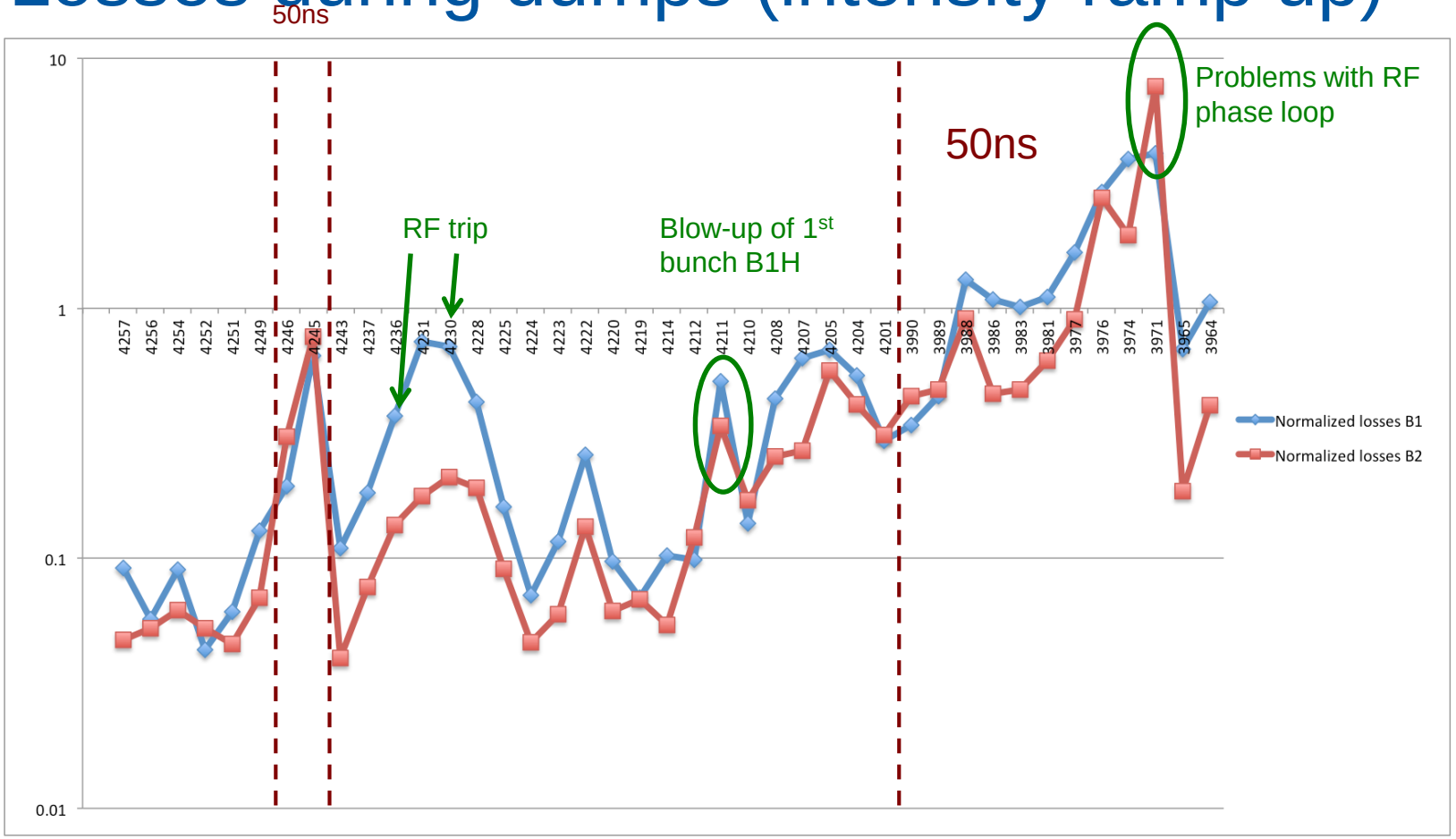
- After re-commissioning following MD and scrubbing, 3 intensity steps → 3 check lists

25ns Intensity ramp-up - Issues

- **Magnet Powering**
  - SEUs in QPS board for splice protection → trips of RBs sectors OR partial trip of sector by PIC due to intermittent opening of quench loop → beams dumped but RBs staid powered → **Replacement of boards** in TS2 AND activation of opening **13kA EE switches via SIS**.
  - QPS_OK flickering → **signal masked**
  - Transient earth fault in RB.A78
  - Earth fault in RCS.A78.B2 → **circuit condemned**
  - Malfunction power supply in **EE switch** of RQTF.A56.B2
  - **Beam induced quench** MB 8L6 due to UFO losses.
  - **Trip of Undulator L4** due to slow increase of offset in U_RES → sequencer check re-activated.
- **Interlocks**
  - UFO dumps → Intensity dependent
- **Collimation**
  - **Disabled temperature sensor** on TCLA.B5L3.B2 due to non-physical behavior.
- **Operation**
  - **Instabilities**
  - **Blow up** of B1 bunches within the first ~300 buckets → dumps when reaching detection limit of BPMs → Shift of filling pattern, BPMs to be run in high gain mode after TS2
  - **BBQ-B1** gating on bunches with high gain → not usable below 2-3TeV
  - Loss of cryo maintain in MS R8.

- **LBDS**
  - MKD compensation power converter trip during ramp-down → replaced.
- **Injection**
  - Losses high in TI2 during injection of 12 and 24b trains.
  - TDI at IP8 interlocked 3x going to injection settings → Seems electronics problem.
- **Heating**
  - **Decrease of bunch length** during fill.
  - **Transients on sector 12** increasing with intensity: now 10 W on top of an heat load of 15 W. Abrupt transients appear after injection and disappear during the ramp on most sectors.
  - TCSP.A4R6.B1 shows a **different thermal dynamics** than all other collimators. Temperature is increasing steadily during stable beam by 1 to 2 C and seems to be building up with short turnover.
  - **TDI temperature reaching 80C**.
  - TOTEM pressure increase in both 6L5 and 6R5 when moving roman pots in.

Losses during dumps (intensity ramp up)



- **Losses** during the dump seem to **reduce over time**.
- 50ns fills have **factor 5-8 higher losses** during dump compared to 25ns fills.
- Analysis **ongoing** – to be understood.

Restart and ramp-up after TS2

SET-UP				
	Full cycle	Probe	Full cycle - chromaticity measurement	shift
	Full cycle	2 nominals + N probes	Full cycle - check collisions	shift
	450 GeV	48b?	Injection set-up plus **lower vertical tune**	
VALIDATION				
	450 GeV	2 nominals + N probes	Full set of loss maps incl. asynch	4 hr
	FT	2 nominals + N probes	FT - loss maps - betatron and one off-momentum	4 hr
	EOS	2 nominals + N probes	EOS - loss maps - betatron	4 hr
	Adjust	2 nominals + N probes	async dump	2 shifts
BUCKET				
			Operation of interlocked BPMs in high gain	
	450 GeV		Injection kicker checks to get back to 900 ns	
	SB		Abort gap cleaning tests in physics	
	450 GeV		TDI checks	
	450 GeV		Injection cleaning and abort gap cleaning checks	
	Collisions	72b on 72b	LRBB studies	shift
	FT	72 50 ns (2 x 36) B1	Instability checks	4 hr
	FT	72 25 ns (2 x 36) B2	Instability checks	4 hr
	Full cycle	Probes	beta* = 90 m - optics measurements...	1-2 shifts
	Comm fill		Commissioning of a few collimator BPMs	1 -2 hrs
RAMP-UP				
	SB	**50 nominal**	**Stable beams**	**1 fill**
	SB	**200 nominal**	**Stable beams**	**1 fill**
	450 GeV		**Scrubbing re-validation**	**2 shifts**
	SB	**450 nominal**	**Stable beams**	

MPS tests / related:

- Virtual beta* for TL collimators.
- TL steering & interlock to block inj of >12b in case of inj. oscillation.
- Redundant opening of 13kA switches by SIS due to PIC interlock.

Further intensity ramp up:

- 450 - 750 –1164 –1740 – 2316 – 2748

Based on M. Lamont slides to LMC 02.08.2015

Conclusion

- 50ns intensity ramp up dominated by **hardware and software** issues in MP systems → **debugging** phase
- End of 50ns and 25ns more and more **intensity and beam related** issues.
- **Limitations around 500b** due to SEUs in QPS boards (→ TS mitigation) and UFOs (→ conditioning?)
- Losses during dump seem to **condition**. **25ns** fills show **significantly cleaner** dumps.
- 25ns **intensity ramp-up to be continued** after TS2.
- A few **out-standing MPS tests** still to be performed.
- Filling of check lists went **extremely smooth.**

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