Increase of BLM thresholds to reduce the number of UFO dumps in matching sections (+decrease at the Q10)

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with valuable input from
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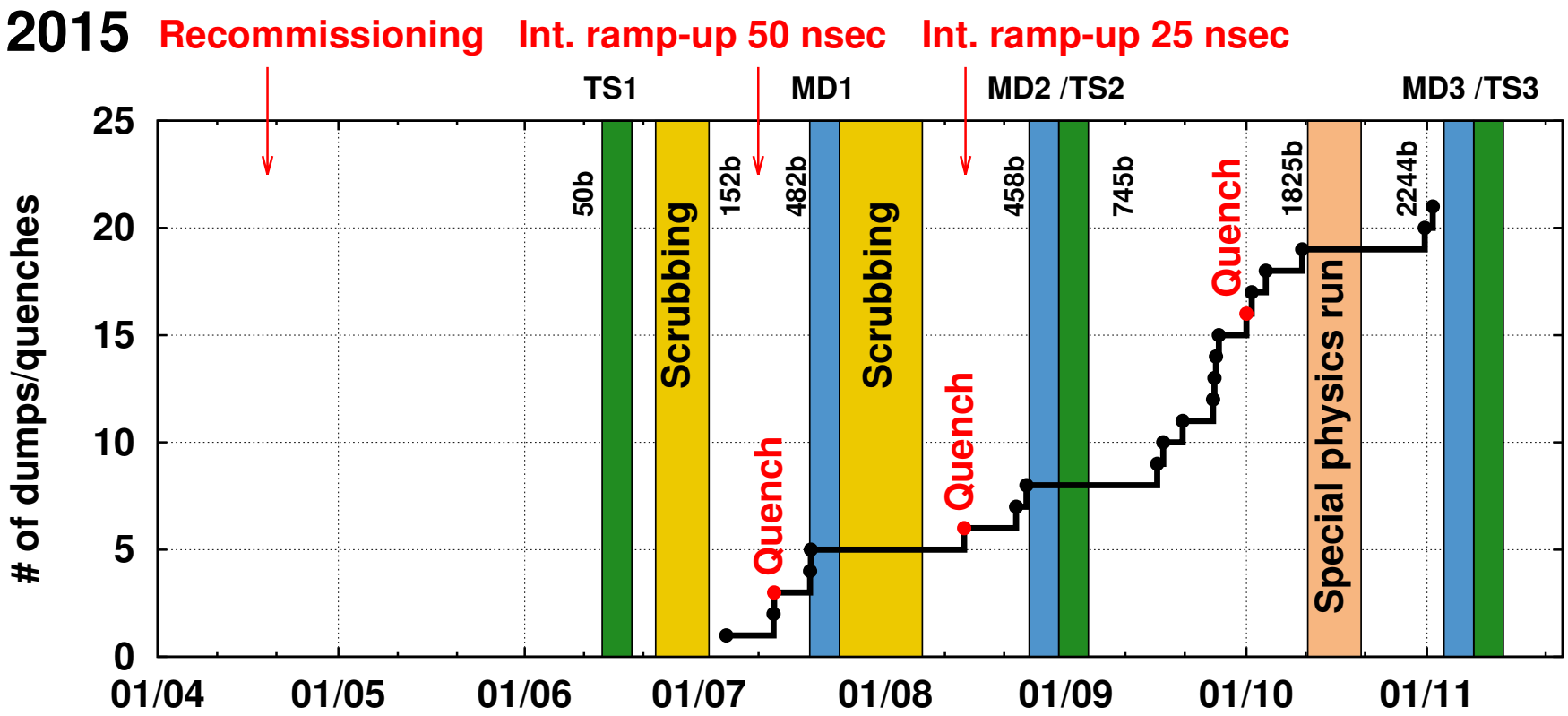
Introduction

- Possible issues with symmetric quenches: for some magnets, symmetric quenches would not (or only with some delay) be detected by the QPS
  - → MQYs: MP3 recommended to lower the QPS threshold for MQYs
  - → MQMs: were so far still under study by MP3
  - → MBX: show in principle a good thermal stability, but the D1.R8 has some issues with the quench heaters
- Decision concerning BLM thresholds in early 2016 (MPP #122, LMC #253):
  - → we start with a conservative MF of 0.1 at IPQs/IPDs and
  - → we re-evaluate the thresholds once MP3 has completed the MQM analysis (assign critical magnets to separate families, relax thresholds for others)
- It is time to act:
  - → Thresholds at IPQs were one of the bottlenecks causing UFO-induced dumps (BLMTWG #38)
  - → MP3 issued recommendations (see talk of G. Willering in this meeting):
    - + OK to increase BLM thresholds on MQMs in the LSS
    - + but need increased BLM protection for Q10

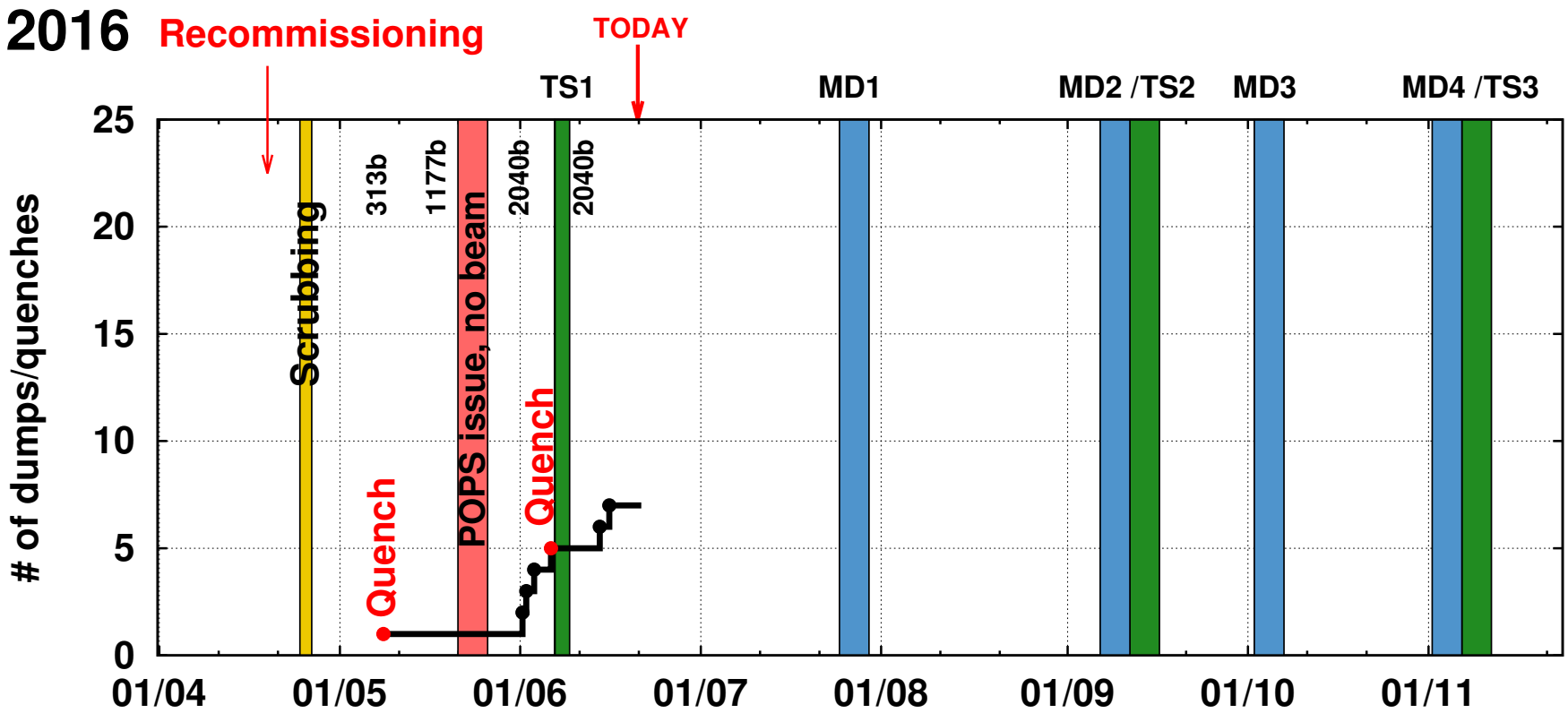
UFO-induced BLM dumps and quenches: recap of 2015



18 BLM dumps, **3 quenches** (without ULO in 15R8)

Data from B. Auchmann

UFO-induced BLM dumps and quenches: so far in 2016

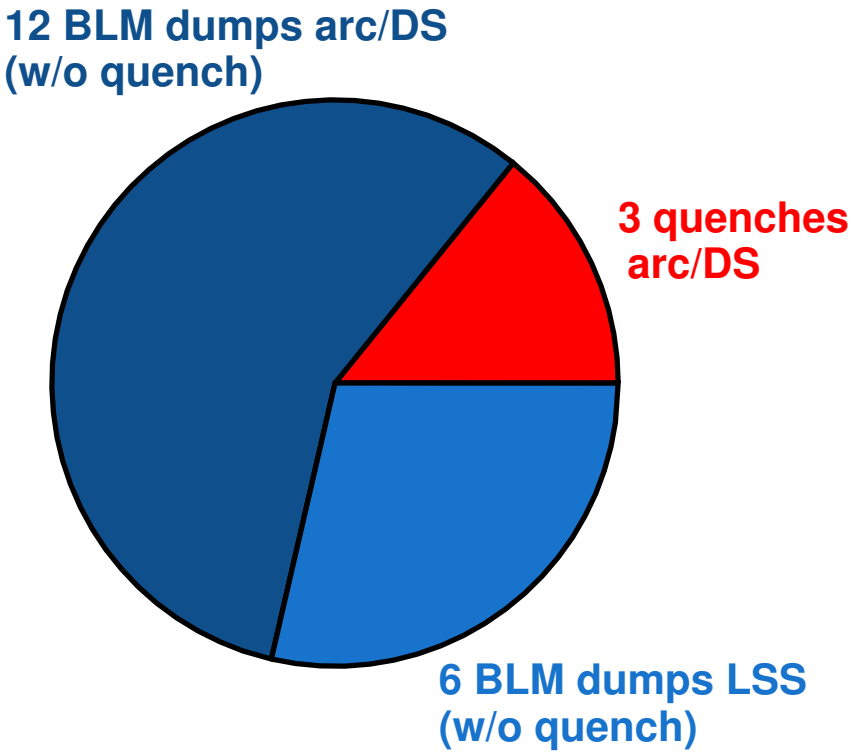


5 BLM dumps, **2 quenches**

Up to 23/06/2016.

UFO-induced BLM dumps and quenches: location

2015 (21 events)



2016 - up to 21/06 (7 events)

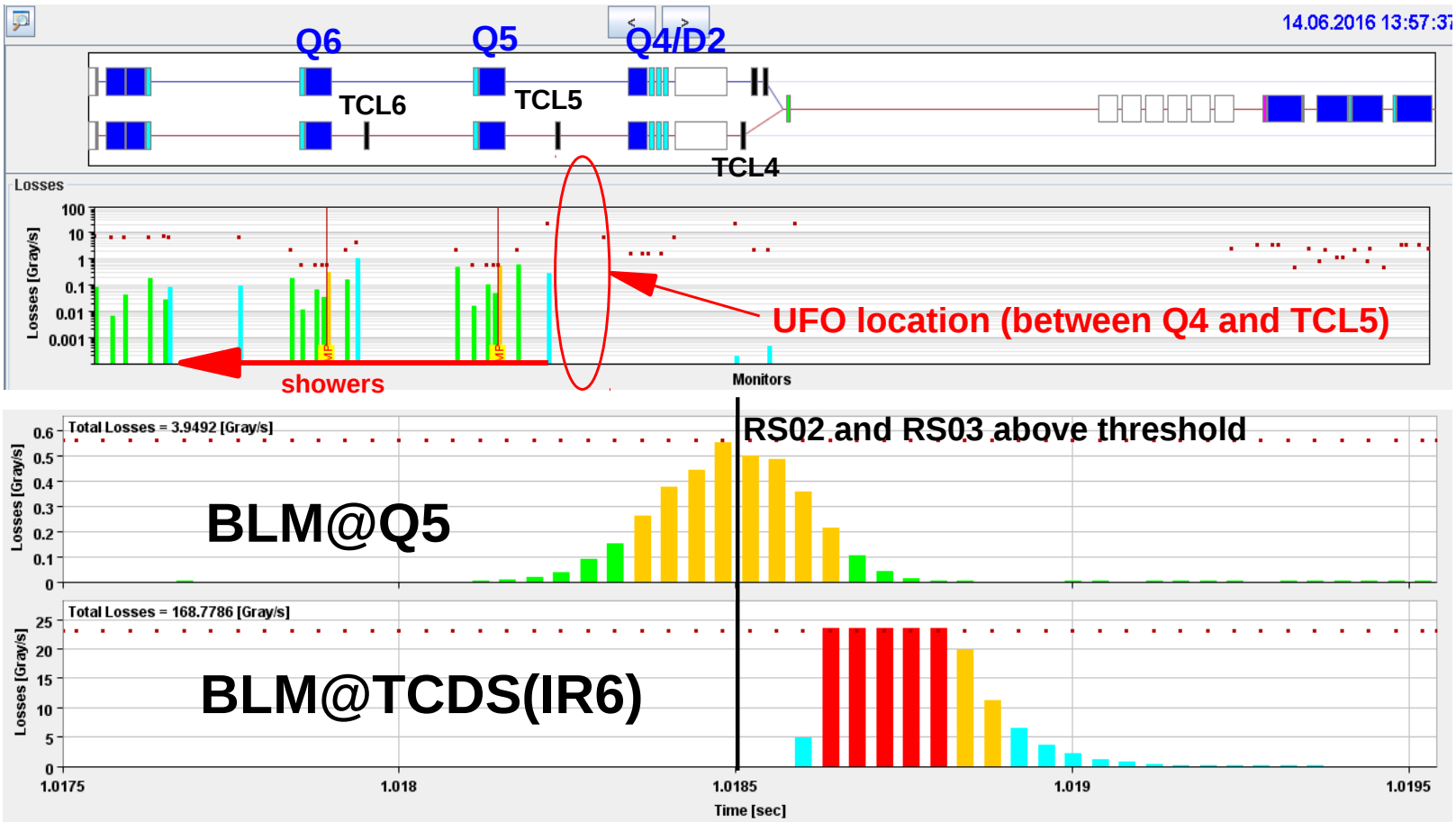
BLM (BCM) dumps in the LSS

Fill	Date (Time)	Beam	IR	BLM dump at	Beam mode
4978	01/06 (13h09)	B1	R5	Q5/XRP.E6R5	ADJUST
4979	02/06 (04h24)	B1	L2	ALICE BCM	STABLE (11h)
4983	03/06 (12h29)	B2	L1	TCL6	ADJUST
5018	14/06 (13h57)	B2	L1	Q5/Q6	ADJUST
5021	16/06 (04h24)	B1	L1	TCTPH	STABLE (8.5h)

+ several more events where we reached a few 10% of BLM thresholds

Dump Fill #5018 (ADJUST)

- UFO upstream of **TCL5 L1**
- Dump triggered by BLMs on **Q5** and **Q6**
- Reached up to 226% of thresholds (usual few turns delay until beam is out)



Proposal of MF change for IPQ/IPD BLMs up to Q6

- Monitor position:
  - → Each IPQ has 3 monitors/beam contained in separate families (upstream end (P1), middle (P2) and downstream (P3))
  - → P3 monitors all have MTs which are set to max (electronic limit), but most monitors still have MFs$<$1
  - → Each IPD has two monitors which are partially in separate families (P1/P2)
- Our proposal:
  - → Increase MF to 0.333 for all P1/P2 monitors at IPQs/IPDs which currently have MF=0.1 (while all monitors with MF$>$0.333 are left unchanged)
    (→ MBX to be discussed)
  - → Set MF to 1.0 for all P3 monitors
  - → Special families for injection regions, wire scanner regions etc. are not touched
- Special families:
  - → MP3 confirmed that we do not need a special family for the Q4 L5/R5 (QPS thresholds cannot be decreased because of noise but there is still enough margin)

Proposal of MF change for IPQ/IPD BLMs up to Q6

Family	# BLMs	Present MF	Proposed MF
THRI.LS.P1_MQM	23	0.1 (all)	0.333 (all)
THRI.LS.P2_MQM	25	0.1 (all)	0.333 (all)
THRI.LS.P3_MQM	25	0.1 (22x) + 0.16 (1xIR2) + 0.3 (2xIR2/8)	1.000 (all)
THRI.LS.P1_MQY	22	0.1 (all)	0.333 (all)
THRI.LS.P1_MQY_FT	8	0.4 (all)	no change
THRI.LS.P2_MQY	32	0.1 (20x) + 0.5 (8xIR6) + 1.0 (4xIR4)	0.333 (20x) + 0.5 (8xIR6) + 1.0 (4xIR4)
THRI.LS.P3_MQY	36	0.3 (34x) + 0.1 (2xIR5)	1.000 (all)
THRI.IP3.P1_MQTL	4	0.4 (all)	no change
THRI.IP7.P1_MQTL_FT	4	0.4 (all)	no change
THRI.IP3.P2_MQTL	4	0.1 (all)	0.333
THRI.IP7.P2_MQTL_FT	4	0.1 (all)	no change
THRI.IP37.P3_MQTL	8	1.0 (all)	no change
THRI.LS.P1_MBX	2	0.1 (all)	tbd
THRI.LS.P2_MBX	2	0.1 (all)	tbd
THRI.LS.P12_MBRC	6	0.1 (all)	0.333 (all)

→*no change to special families for injection regions, wire scanners etc.*

Q10 magnets

- Of all MQMs the worst case are the Q10 magnets (D. Wollmann, A. Verweij):
  - → they are at 1.9 K with the highest currents hence they have the smallest margins in case of a quench
  - → there is a relatively high noise levels on the quench detection cabling
  - → a reduction of QPS thresholds is hence not favourable as it might lead to a significantly increased number of false trips → increased BLM protection is desirable
  - → sufficient to prevent beam-induced quenches in the Q10s themselves but not necessarily in neighbouring dipoles (in the latter case the Q10 currents would be sufficiently down when the helium arrives, hence leaving more margin)
- To protect against UFOs, we propose the same strategy as for the ULO:
  - → Create a special family for P1 monitors at Q10s which derives from the 2015 family (without AdHoc UFO increase applied in 2016)
  - → Adopt a MF of 0.15 for this family (currently we have 0.333)
  - → Implies a factor 6 decrease in the short RSs (up to RS05) and a factor two decrease in long RSs
- To protect against local losses on the MQM aperture (orbit bumps etc.):
  - → Create a special family for P3 monitors at Q10s which derives from the 2016 family
  - → Adopt a MF of 0.15 for this family (currently we have 0.333)

Concluding remarks

- UFOs in the LSSs:
  - $\rightarrow$ With the new MF proposed for IPQs (0.333) we would have avoided one dump caused by a UFO (in another case we were still limited by XPR thresholds)
  - $\rightarrow$ Increasing the MF at IPQs leaves other threshold bottlenecks for UFOs (TCLs, TCTs and XRPs), which we will address in the near future