Which tests shall we present in the paper?

M. Sapinski,
with great help from Agnieszka Priebe
QTAWG, 2014.01.17

Discussion of the paper scope

1. Document experience with beam-induced quenches during Run 1.
2. Present common method used for quench analysis (tracking > impact distribution > FLUKA).
3. Present measured quench levels.
4. ?

So if quench test or a quench is not presented that is because:

A. We have another similar test (beam energy and loss timescale) giving, for some reason, better result.
B. Not enough data to perform reasonable simulations at precision comparable with other tests.
C. Expected doubtful result and a lot of work to be done.
D. Quench well above quench level

Outlook: complete list of quench tests

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

And other losses which did not lead to quench!

Quench tests described in the paper now

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

5 out of 21

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

We have good reasons to choose these tests, but maybe there is something interesting we are leaving out?

Quench 1

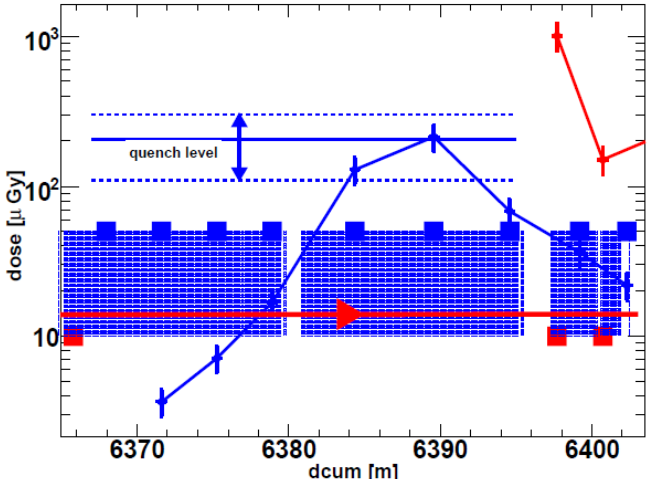
TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

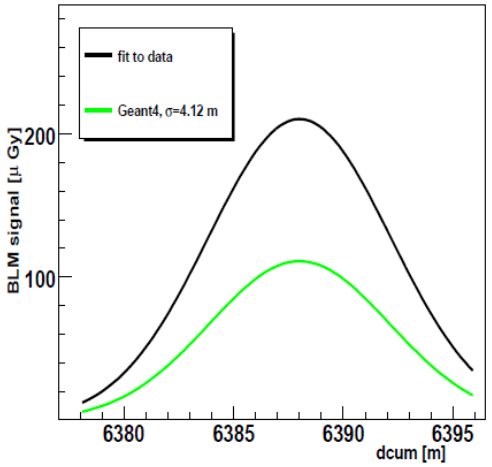
No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 1 - A

- described in LHC-Project_Note 422 (2008)
- classified as quenchino
- 4 ·10^9 protons impacting with angle 250-300 μrad on MB.B8L3
- vertical loss
- kicking magnet: MCBV.9R2.B1 – MQ between quenched magnet and kicker
- Geant4 done assuming gaussian longitudinal loss profile
- underestimation of BLM signal (as in recent Agnieszka's simulations)
- QL: 13-50 mJ/cm^3





Quench 2

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 2

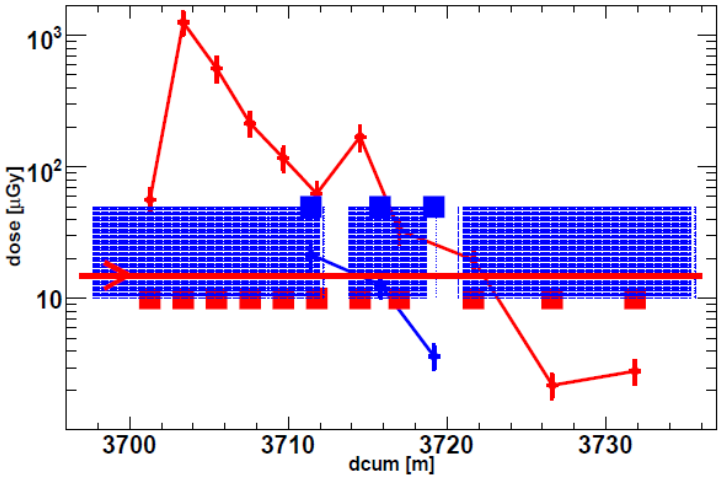
- described in LHC-Project_Note 422 (2008)
- classified as quenchino
- 2 ·10^9 protons impacting with angle

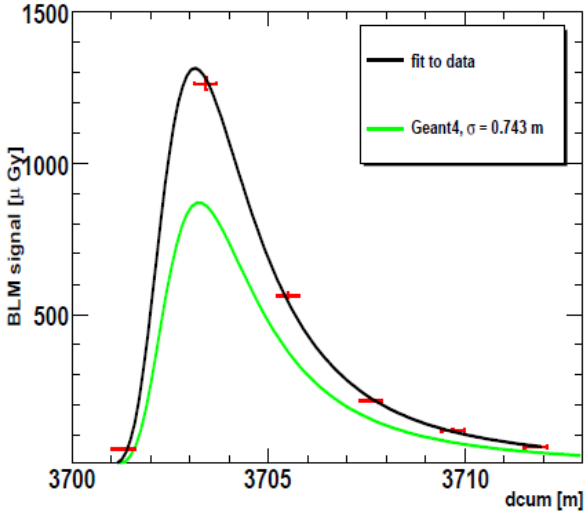
750 µrad on MB.B10R2

- vertical loss
- kicking magnet: MCBV.9R2.B1 (20 m from MB)
- Geant4 done assuming gaussian longitudinal

loss profile

- QL: 16 mJ/cm^3





Quench 3 and 4

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 3 and 4 - AB

- Similar to quench 1
- Quenched are arc MBs, so no BLMs in vicinity, difficult to cross-check FLUKA simulations.
- Not much effort was spend to look at these quenches, someone should have a look.

Quench 5

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 5 – A and C?

- Operational quench
- analyzed by Rob Appleby / Rudiger Schmidt (presented in 2010)
- no FLUKA
- Pilot Injection (8e9) in LHC with wrong MQD currents
- 4 dipoles quenched
- Rather useless as a quench test

  (complex beam trajectory, difficult source term)

Quenches 6-8

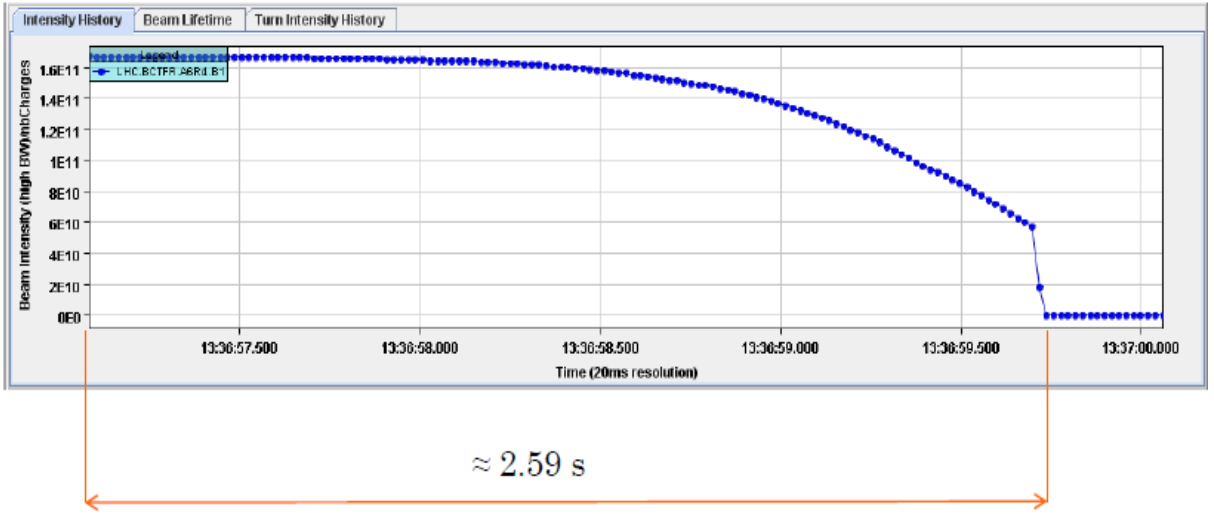
TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quenches 6-8 – B and C?

- 1s quench tests with 450 GeV beam and dynamic orbit bump, partly documented in A. Priebe BI student meetings presentations and M. Sapinski MPP 2010.10.29
- unfortunately collimators were closed so part of the intensity was lost there
- all in cell 14R2
- unresolved puzzle: for vertical bump we quenched MQ, for horizontal: MB
- maybe we should have a look at these tests? Vera expressed her interest in looking at dynamic bump in MADX



Quench 9

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

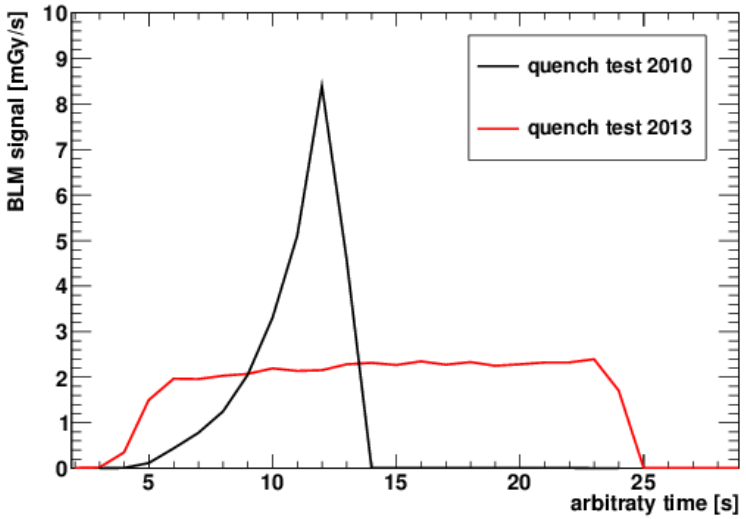
18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 9 - A

- 5s quench tests with 3.5 TeV beam and dynamic orbit bump
- unfortunately collimators were closed so part of the intensity was lost there
- Cell 14R2 (well known)
- described well in publications: IEEE Transactions on Applied Superconductivity, Volume: PP, Issue: 99, IPAC11, CERN-ATS-2011-058 , Agnieszka's PhD thesis
- main argument to skip this:

We have a better one!

- But if we look again at previous ones it would be natural to look at this one



Quench 11

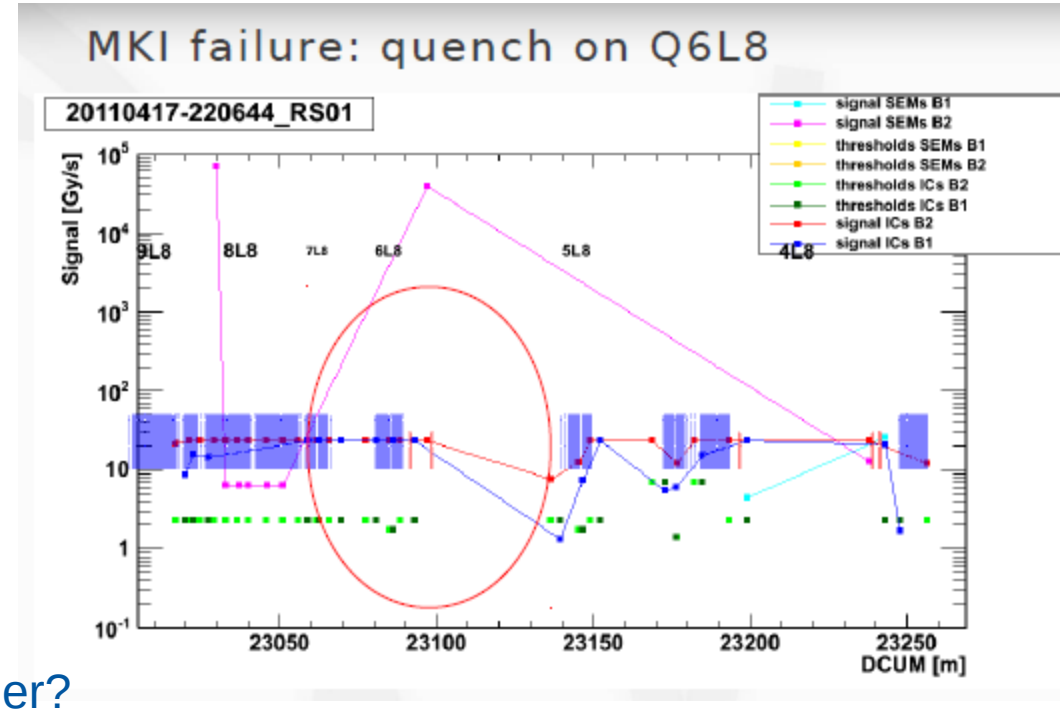
TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 11 – D?

- Injection kicker flashover, some bunches on TCLIB
- large fraction of injected beam (72 bunches) – about 7e11 protons on TDI, 11 magnets quenched (9 MBs)
- Documented: Annika Nordt (MPP 2011/05/13)
- FLUKA done, Anton et al., IPAC13
- many BLM monitors in saturation
- Many magnets quenched well above Quench Limit, but maybe we could learn something from other?



Quench 12

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 12

- Radmon/BLM cross-calibration MD
- at one of the shots magnet quenched (still cell 14R2)
- Documented in CERN-ATS-Note-2011-070 MD (Marco Calviani)
- it was orbital bump with small impact angle – only part of the beam on the magnet, rest in the dump
- various bump amplitude used, so shots without and finally with quench

Quench 13

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 13 - D

- Triplets L2 and D1/D2 R2 quenched
- MKI erratic > strong oscillations of the circulating beam
- loss over several turns
- Documented: Anton et al., IPAC13 (FLUKA exists)
- I have impression quenches were too much above quench limit to learn anything about it.

Quench 14

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 14 – D?

- another kicker flashover
- documentation? FLUKA?
- probably difficult loss pattern (as before)

Quench test 18

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench 18 – B?

- Documented in ATS/Note/2012/081 MD
- any chance to get simulations to the same level as proton collimation test?

Quench tests 19 and 21

TABLE I. List of beam-induced quenches in the years 2008-2013. Quenches 10, 15, 16, and 17 are analyzed in this paper.

No	Date	Energy [TeV]	Loss Duration	Quenched Magnet	Magnet Temperature	Remark
1	2008.08.09	0.45	~ ns	MB	1.9 K	beam setup
2	2008.09.07	0.45	~ ns	MB	1.9 K	beam setup
3	2009.11.20	0.45	~ ns	MB	1.9 K	beam setup
4	2009.12.04	0.45	~ ns	MB	1.9 K	beam setup
5	2010.04.18	0.45	~ ns	MB+	1.9 K	wrong quad current
6	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
7	2010.10.06	0.45	1 s	MQ	1.9 K	quench test
8	2010.10.06	0.45	1 s	MB	1.9 K	quench test
9	2010.10.17	3.5	6 s	MQ	1.9 K	quench test, Sec. VI B
10	2010.11.01	3.5	10 – 40 ms	MBRB	4.5 K	quench test, Sec. V A
11	2011.04.18	0.45	~ ns	MB+	1.9 K	kicker flashover
12	2011.07.04	0.45	~ ns	MB	1.9 K	test
13	2011.07.28	0.45	~ ns	MQXB+	1.9 K	injection oscillations
14	2012.04.15	0.45	~ ns	MB+	1.9 K	kicker flashover
15	2013.02.15	0.45/6	~ ns	MQM	4.5 K	quench test, Sec. IV A
16	2013.02.15	4.0	5 – 10 ms	MQ	1.9 K	quench test, Sec. V B
17	2013.02.16	4.0	20 s	MQ	1.9 K	quench test, Sec. VI C

18. 2011 ion collimation quench tests
19. 2011 proton collimation quench test
20. 2013 proton collimation quench test
21. 2011 Q6 quench test

Quench tests 19 and 21 - A

- First versions of tests which we do present

Summary

- One quench (2) found interesting and easy to simulate (FLUKA)
- Tests 6-9 found relatively interesting but need significant work (MADX+FLUKA)
- Quenches 11 and 13 already simulated – need to analyse result from the paper point of view
- Quench test 12 found interesting (MADX+FLUKA)
- Quench 14 – another kicker flashover – question to Chiara, Anton
- Collimation quench test with ions – significant work needed, any chance to get similar precision as with protons? (Sixtrack+FLUKA)
- Definitely the tests we have chosen are the most interesting, but we have data in two regimes (ns and 1s at 450 GeV) we have not yet in the paper