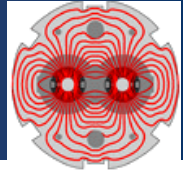
The latest quench tests planning

Mariusz Sapinski BE/BI

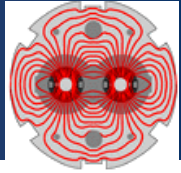
MPP, 2013/01/25

Outlook



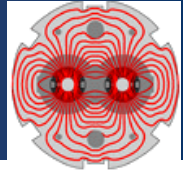
1. MPP documents
2. Things to be done before quench MD
3. Short description of the five tests
4. Assumed durations
5. Planning

MPP documents



Test name	Status
ADT Fast Losses	Draft for discussion, EDMS 1263345
Collimation tests	In writting
Steady state with orbital bump	Draft for discussion, EDMS 1263798
Q6 injection	Send to Markus

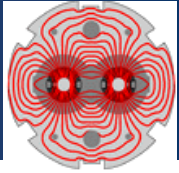
To be done before the quench MD



TEST PERIOD: Feb 11, 6 am (Monday) - Feb 13, 6 am (Wednesday)

Test name	Action
ADT fast losses	1. Installation of scope for fast acquisition of QPS signal (1 hour access) 2. ADT settings and low sensitivity check (6 hours at 450 GeV).
Collimation quench test with protons	Perform a **minimum of MP validations** with the relaxed collimator settings (transverse loss maps -for BLM threshold change, asynchronous beam dump…?) Time: 3-4 hours ?
Q6 test at injection	Installation of the scope for fast acquisition of QPS signal. (1 hour access)

ADT fast losses quench test



Goal: **investigate quench limit at 1 ms** timescale

- estimate impact of UFOs on operation after LS1

Challenges:

1. Generate 1 ms losses at 4 TeV (beam rigidity!)
2. Target magnet with very low intensity:1e8 - 1e9 protons

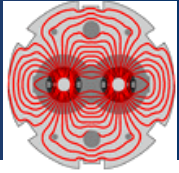
Proposed method:

1. Create orbital bump (without touching the beam screen)
2. Open horizontal collimators (so that the magnet is aperture limitation)
3. Scrape bunch intensity by blowing it vertically (ADT)
4. Apply horizontal ADT excitation (sign flip)

Machine protection:

1. Loss up to 1e9 protons at 4 TeV on the magnet, total intensity in the machine < 1e11
2. Masking IR6 BPM interlock and collimation interlock
3. Raise BLM thresholds to allow magnet quench and scraping without premature dump

Collimation quench tests



Goals:

• Measure collimation **performance limitation** for operation **at 7TeV** due to leakage from the cleaning insertion into the magnets of the IR7-DS

• Measure the **quench limit** in the DS magnets (Q8, Q9 for protons, Q9, Q11 or Q15 for ions) (this measurement will be difficult to translate to mJ/cc, but will give BLM signal at quench)

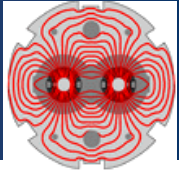
Method: blow the beam with ADT (white noise), lose on collimators in IR7

Machine protection:

1. constant losses of 500kW (~7.5e11 protons/s on collimators @ 4 TeV) for 10s
2. maximum allowed constant loss rate into IR7 primary collimators of 1MW (~1.5e12 protons/s on collimators @ 4TeV) for 5s
3. For ions the maximum loss rate of 1.75e11 charges/s (~112kW) for 10s
4. Raise BLM thresholds to allow quenching before dump

see Collimation WG on Monday for more detailed discussion.

Steady-state orbital bump quench test



Goal: **investigate steady-state quench limit at 10 s**

- This test does not correspond to realistic loss scenario but allows determination of quench limit in the magnet coli (in mJ/cc).

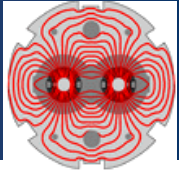
Method:

1. Create orbital bump
2. Open horizontal collimators (so that the magnet is aperture limitation)
3. Apply horizontal ADT excitation (white noise)

Machine protection:

1. Loss of 1e9 p/s to 4e9 p/s on the magnet for 10 s
2. Beam in the machine 10x1e11 protons
3. Masking IR6 BPM interlock and collimation interlock
4. Raise BLM thresholds to allow magnet quench without premature dump

Q6 at injection



Goal: **investigate very fast loss quench limit for energies up to 7 TeV**

- interesting for studies of asynchronous dump impact of on magnets

Proposed method:

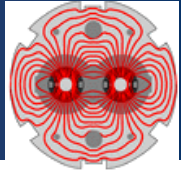
Shot on closed TCLIB collimator, quench the magnet behind increasing its current up to ultimate value (7 TeV)

Challenge: Perform this test when quench recovery in Q12L6 ongoing

Machine protection:

1. Loss up to 1e11 protons on the TCLIB collimator
2. Mask all maskable BLMs
3. Mask collimator interlock
4. Increase probe beam limit to 1e11
5. Q6 magnet was commissioned to 7 TeV (4310 A) in 2008.

Assumed duration of various phases



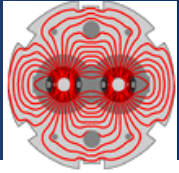
Assumed durations:

- Test duration 3 h, including injection, ramp up and the test itself
- 2 h for the ramp for ADT setup
- If dump without quench: 3 h, including ramp-down, precycle, setup
- If quench: 5 hours, including ramp-down, quench recovery, precycle, setup (optimistic?)

Overview of planning

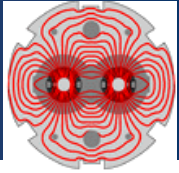
Collimation ions Stefano, Belen, Daniel	**Because of depletion of lead in the oven**	Monday 06:00
ADT fast loss Agnieszka	**High priority, most difficult**	Monday 20:00
Collimation protons Stefano, Belen, Daniel	**High priority**	Tuesday 04:00
Steady state with orbital bump Agnieszka	**Especially interesting if collimation with protons do not quench**	Tuesday 17:00
Q6 injection Chiara, Wolfgang, Matteo	**Maybe can be done during other magnet recovery**	Wed 01:00

Quench tests planning (I)



Time	MD	beam	comments	accumulated time
06:00	*Ramp down if needed*		Prepare BLM thresholds and ADT settings	
07:00	**Ion collimation**, ramp 1	8 bunches, 4ZTeV, beam 2 total intensity < 3e11 ch	validation of ADT gain	1
09:00	*ramp down, precycle*			3
12:00	**Ion collimation**, ramp 2	3 trains of 75 bunches, 4 ZTeV, total intensity about 2.9e12 ch	Quench expected (L7)	6
15:00	*Ramp down, quench recovery, precycle*		Preparation of ADT settings for fast losses test	9
20:00	**ADT fast losses**, ramp 1	10x5e9 @ 4 TeV	Quench expected 12L6	14
23:00	*Ramp down, quench recovery, precycle*		Preparation of BLM thresholds for proton collimation test	17
if no quench reached: second ramp needed: + 3 h				
04:00	**Proton collimation** , ramp 1	3 bunches, 4 TeV, beam 2 total intensity<9e11	Validation of ADT settings	22
06:00	*Ramp down, precycle*		Setup BLM thresholds	24

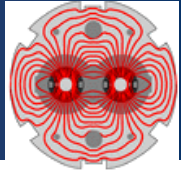
Quench tests planning (II)



Time	MD	beam	comments	accumulated Time
09:00	**Proton collimation QT**, ramp 2	3 trains of 50 – 150 bunches @ 4 TeV	Quench expected (L7)	27
12:00	*Ramp down, quench recovery, precycle*		Prepare BLM ,ADT settings,	30
if no quench reached: second ramp needed: + 3 h				
17:00	**Steady-state with bump**,	10 x 1e11 @ 4 TeV	Quench expected (12L6). **Additional ramp if enough time**	35
20:00	*ramp down, quench recovery, precycle*			38
if no quench reached: second ramp needed: + 3 h				
01:00	**Q6 injection QT**	Fat pilot at injection B2, Q6 magnet at higher currents (5 TeV +)	Can start independently of quench recovery in 12L6. Quench expected (6L8).	43
04:00	*END*			**46**

- 46 hours assuming 100% machine availability – minimum
- up to 55 hours if quench ramps fail in the first attempt

Conclusions



- 2 hours of access needed (in the shadow of other accesses)
- 10 hours of preparation time with the beam (setting validation, ADT calibration)
- 46-55 hours for the whole program of tests assuming 100% machine availability
- 5 quenches expected

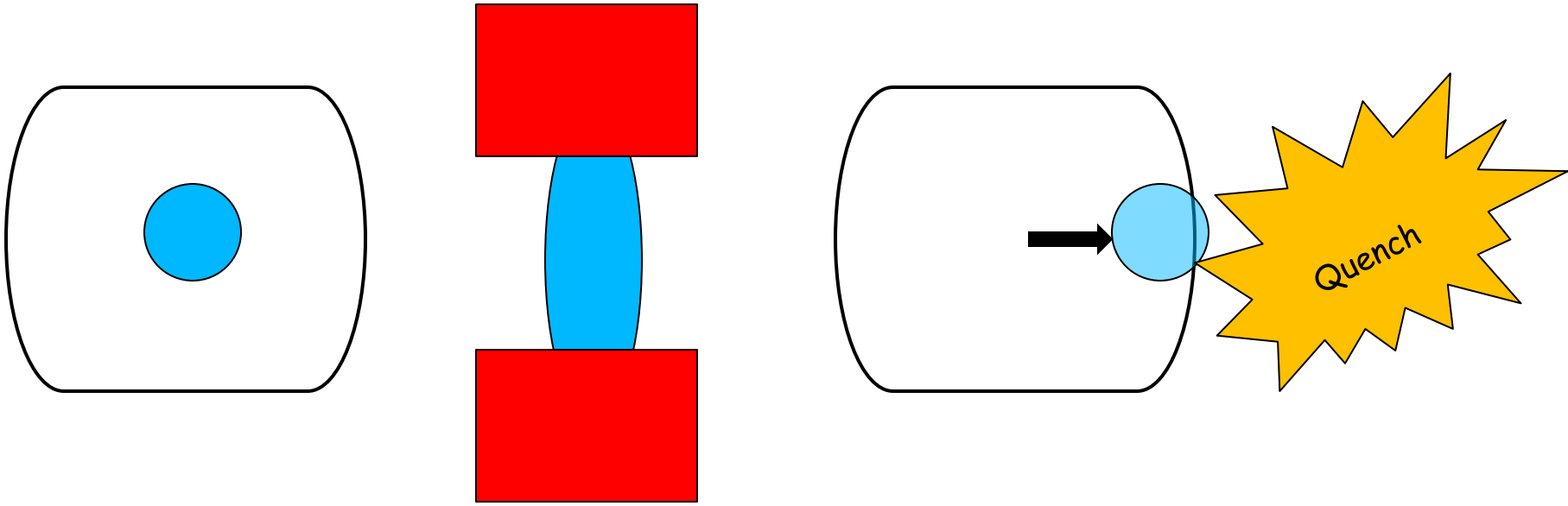
SPARE SLIDES

ADT fast losses QT - idea

1. Inject and ramp

2. Blow-up vertically and scrape

3. Excite horizontally and quench



(*) Not in scale

Open points concerning ADT fast losses QT