Orbital Bump Quench Tests

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Summary of the orbital bump Quench Tests

Quench Test Summary (C14R2)

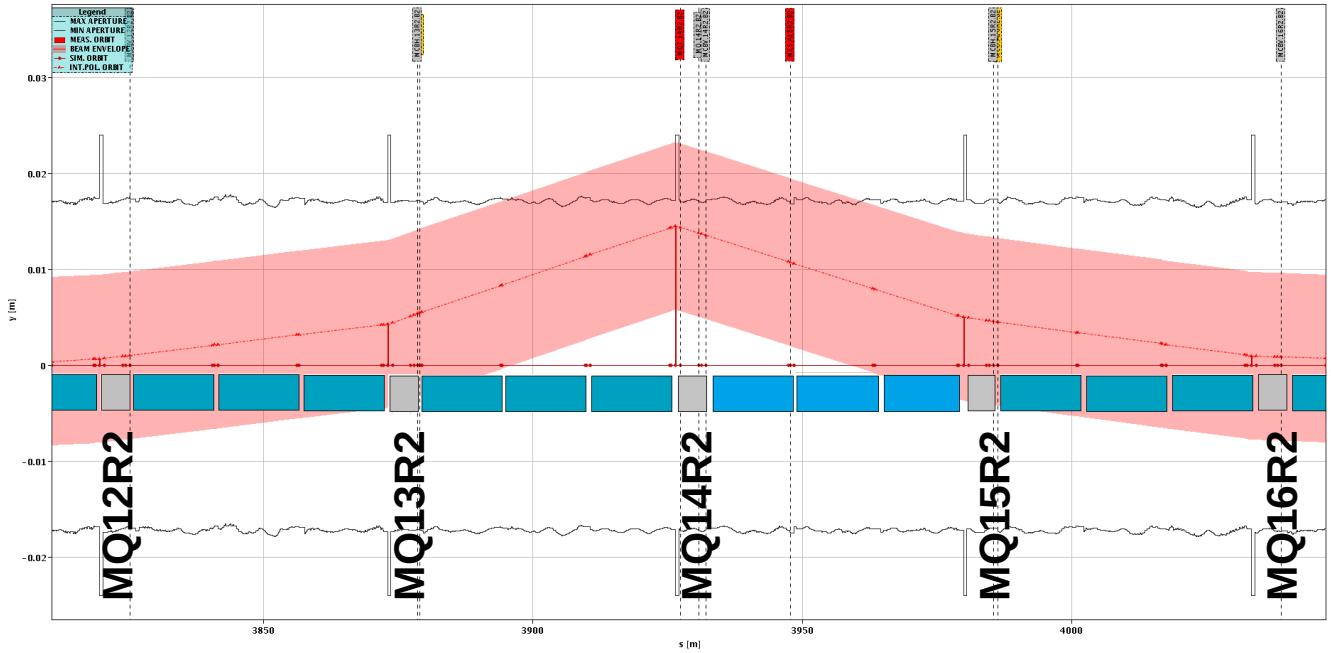
No	Date	Time	Beam	Orientation	Energy [TeV]	Quenching element	Loss duration* [s]
1	6.10 2010	10:13:58	2	vertical	0.45	13 kA Q bus QPS	1.7
2	6.10 2010	12:35:11	2	vertical	0.45	13 kA Q bus QPS	1.8
3	6.10 2010	13:37:00	1	horizontal	0.45	13 kA B mag QPS	0.9
4	17.10 2010	20:23:13	2	vertical	3.5	13 kA Q bus QPS	3.32

* The beginning of the loss chosen to be at 90% of max current of BCT

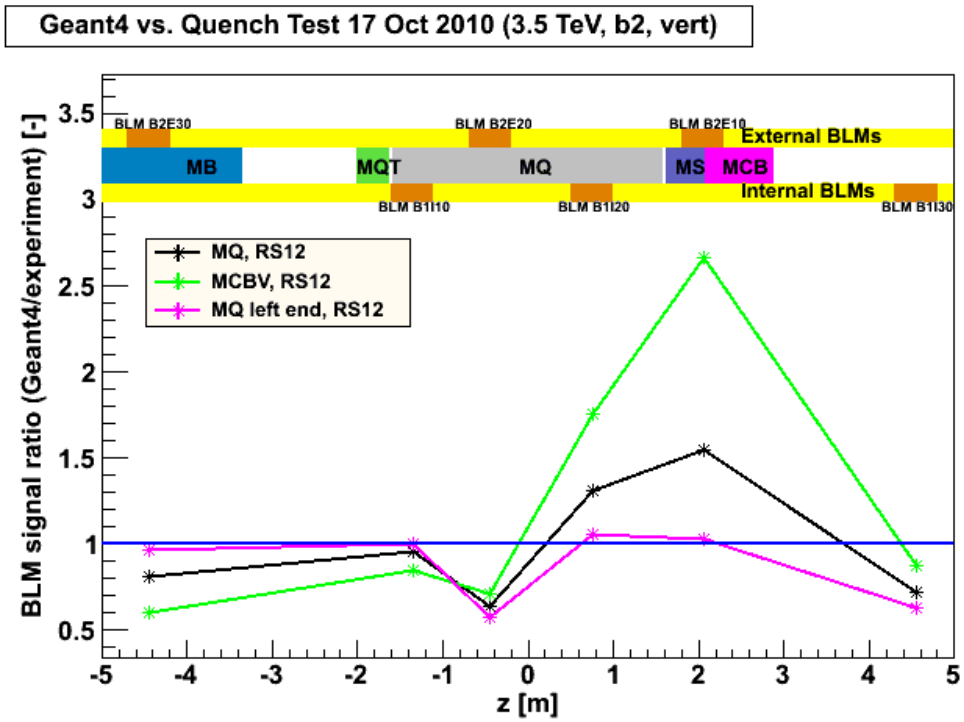
MB quench

Up to now, the longest beam loss resulting in quench

No tests in 2011 !!!



CONCLUSIONS FROM 2010 TESTS



- ✓ BLM thresholds were lowered
- ✓ Geant4 and QP3 analysis almost finalized
- ✓ Good agreement with experimental BLM data

	Geant 4 [mJ/cm³]	QP3 [mJ/cm³]	Note 44 [mJ/cm³]
MQ centre	1370	550	250
MQ end	1526	551	
MQ end 70% of losses (=>28%)	694	524	

Confidence in quench limit estimations

What do we need to learn in 2012?

Outcome from Chamonix 2012:

- UFO quench limit is an critical issue

+

Another important issue:

- Steady state losses must be understood

Solution:

- Both cases can be studied with the orbital bump method
  - BLM orbit feedback
  - The LHC Transverse Damper (ADT)

Advantages:

- Orbital bumps are well-known and well-controlled
- Test with a low intensity beam
- Safe cell C17R5 chosen (in terms of magnet protection, cryogenics and vacuum)
- Geant4 simulations are ready for an analysis
- 7 additional BLMs to be installed (a higher resolution of data acquisition)
- Possibility to perform tests without quenching the magnets

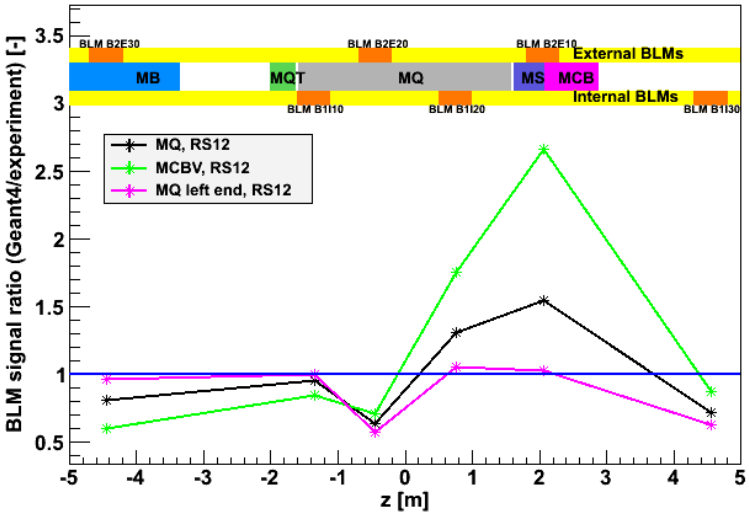
THANK YOU FOR YOUR ATTENTION !

BACK-UP SLIDES

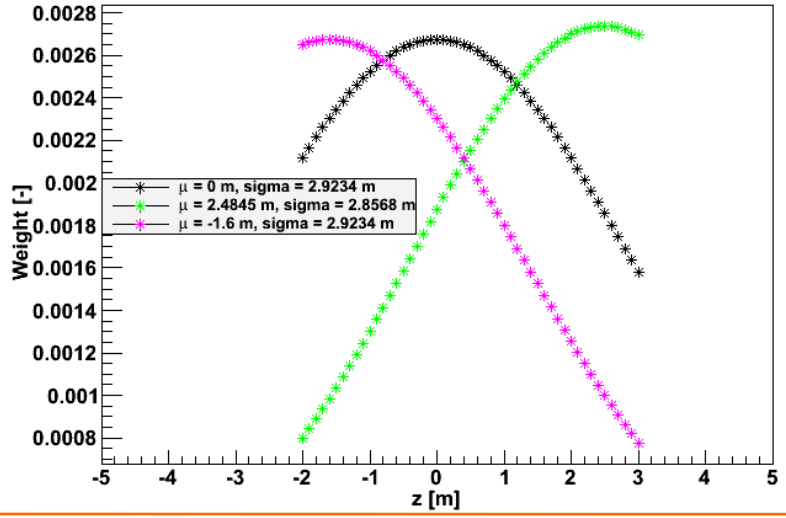
Quench Test 17 Oct 2010

Comparison between Geant4 simulations and experimental data

Geant4 vs. Quench Test 17 Oct 2010 (3.5 TeV, b2, vert)



Applied Gaussian weights



Comparison between Geant4 simulations and QP3 heat transfer code

	Geant 4 [mJ/cm^3]	QP3 [mJ/cm^3]	Geant4/QP3 [-]
MQ centre	1369.55	549.80	2.49
MQ end	1526.24	550.93	2.77
MQ centre ½ Gaussian	2002.11	547.78	3.65
MQ end 90% of intensity (=>48%)	1248.74	442.10	2.82
MQ end 80% of intensity (=>38%)	971.24	382.06	2.54
MQ end 70% of intensity (=>28%)	693.75	325.96	2.13
MQ end 90% of losses (=>48%)	1248.74	543.62	2.30
MQ end 80% of losses (=>38%)	971.24	537.07	1.81
MQ end 70% of losses (=>28%)	693.75	523.97	1.32
MCBV	1333.64	548.48	2.43
MCBV ½ Gaussian	1825.92	548.52	3.33

Preliminary analysis shows good agreement between experiment and simulations.

The upgrades are ongoing.

PLAN FOR QUENCH TEST 2012

Plan: Beam bump controlled by a BLM orbit feedback

MULTI – LEVEL STUDIES

→ **Steady state losses**

→ Loss duration: **~1 minute**

→ 2 stages:

- magnet quench with 3.5 TeV (→ BLM signal S)
- operation at 90 % of S

→ **New location: C17R5** (good in terms of magnet protection, cryogenics and vacuum)

→ 7 additional BLMs will be installed

→ New system for QPS (faster, higher resolution) will be used

→ Observation of energy deposition in a magnet (cryogenics measurements)

→ If possible, both beams would be used

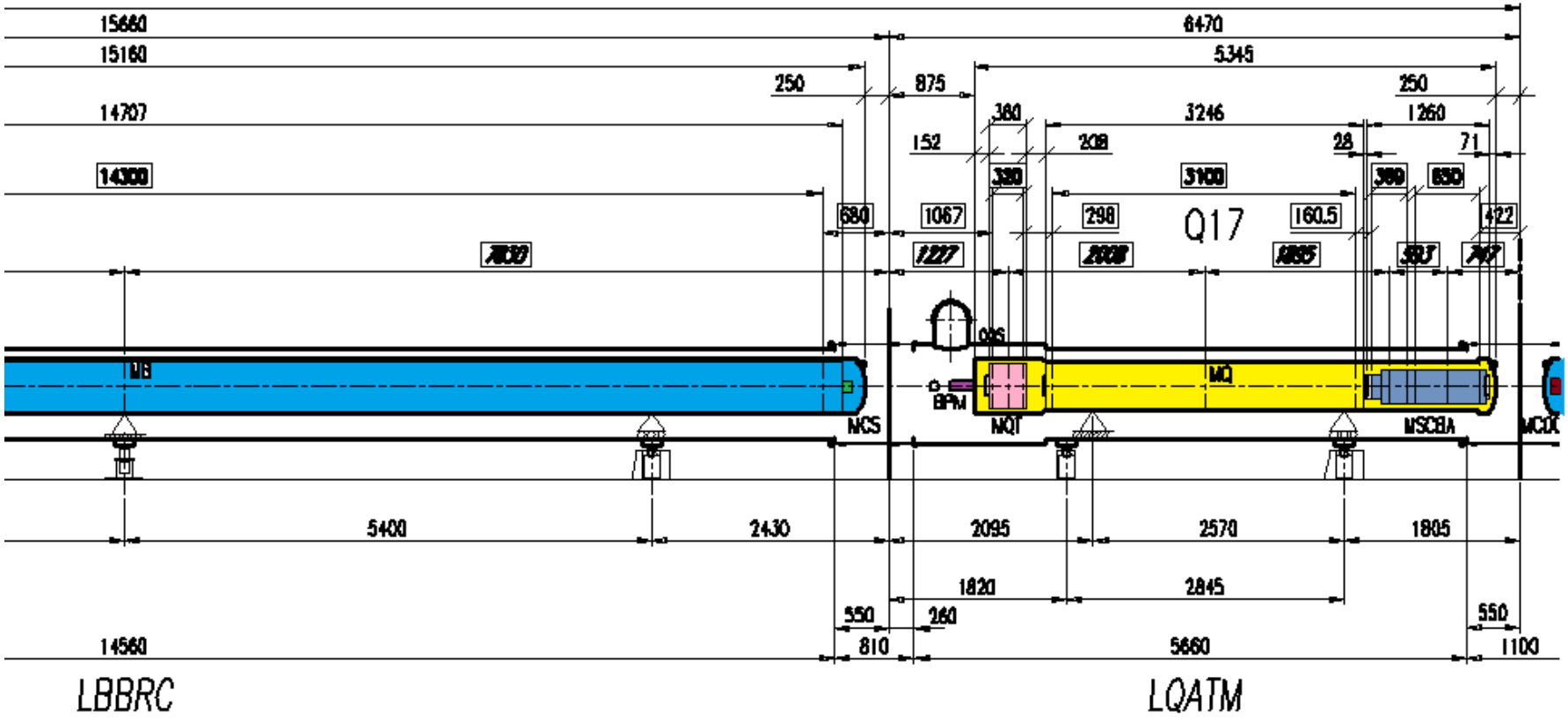
→ Configuration of beams:

- beam 1:external, H
- beam 2: internal, V

Why?

- we don't have experiments for steady state losses (are the set BLM thresholds OK?)
- to improve statistics for nominal energy
- we have Geant4 simulations prepared ☺
- required studies for LHC upgrades and future magnet technologies

LAYOUT

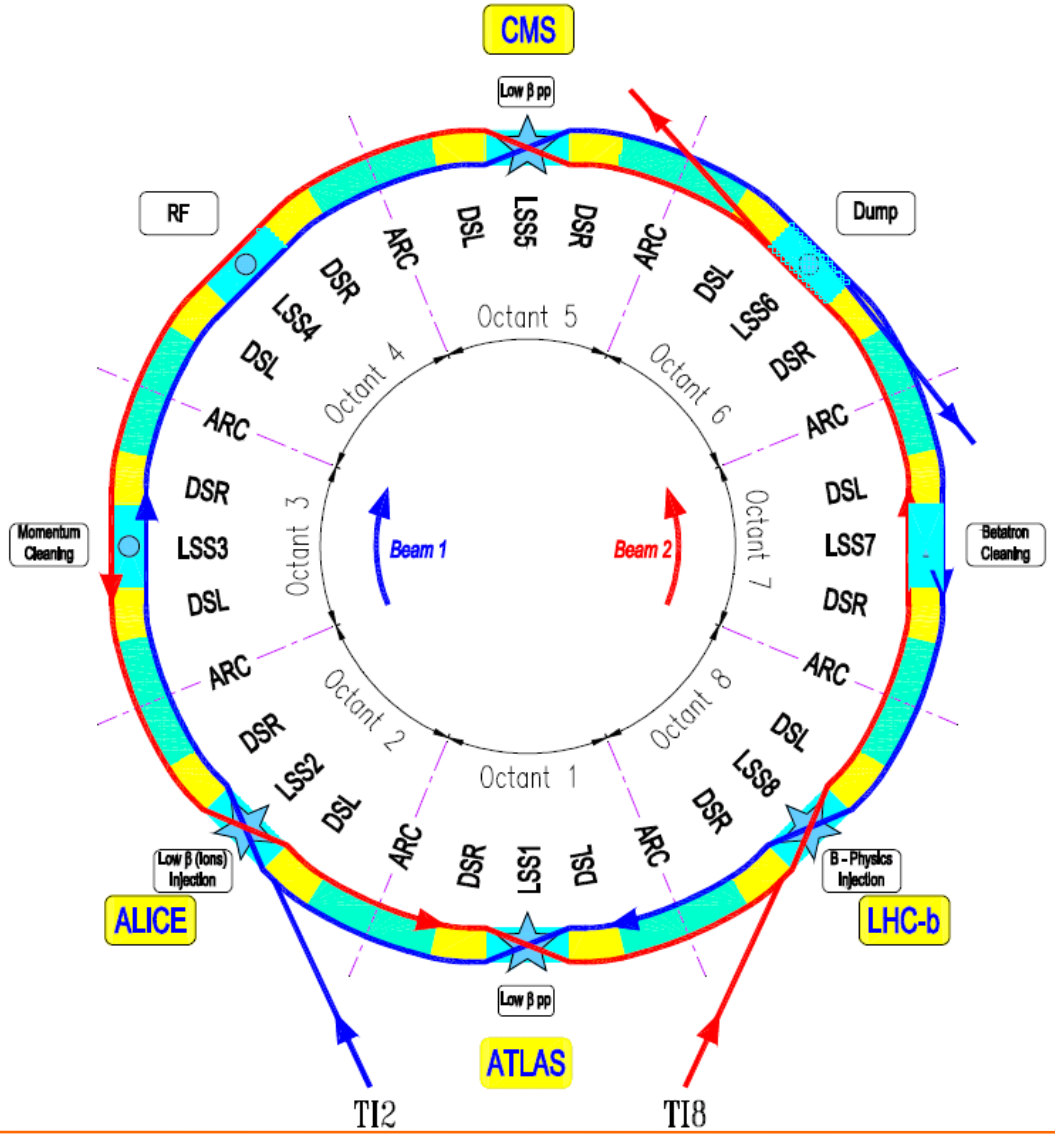


MSCBA :
- external aperture: MS+MCBH (focusing)
- internal aperture: MS+MCBV MCDO in MBA

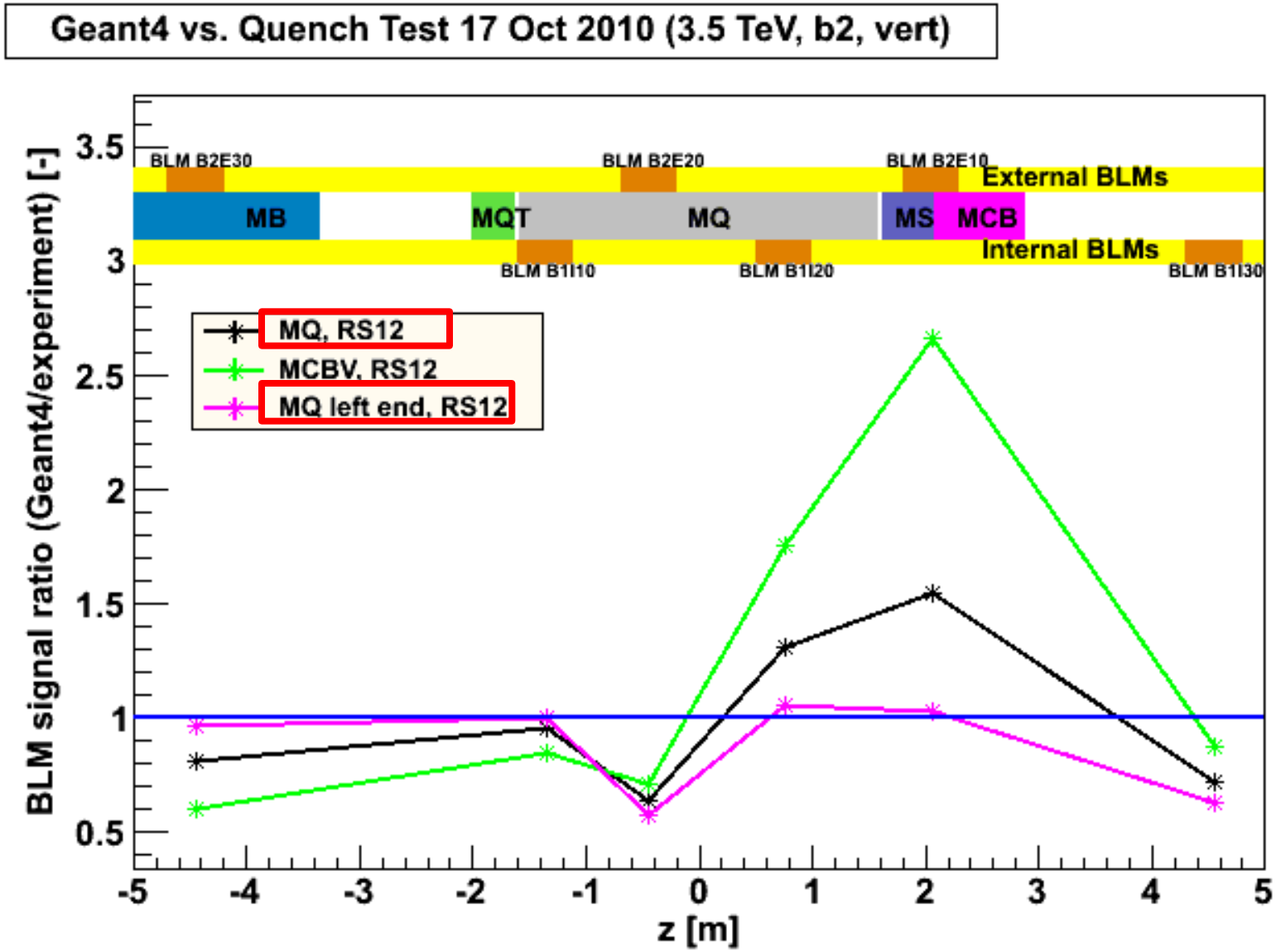
LHCLSA__0017

LAYOUT

Schematic layout of the LHC. Beam 1 circulates clockwise and Beam 2 counter-clockwise.
(LHC Design Report, Chapter 3)



BLM SIGNALS



Comparison of integrated signals (RS12=sum over all signal [Gy/s]*84 [s])