LS1: BLM reconfiguration

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Proposed Change of BLM Positions in the Arcs During LS1

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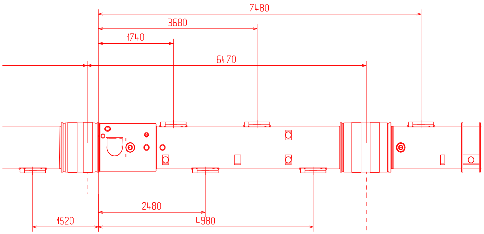
CERN - BE-BI

MPP October 12, 2012

Outline

Current BLM configuration in arc cell

Position after integration



← on both sides about 45 meters without BLMs →

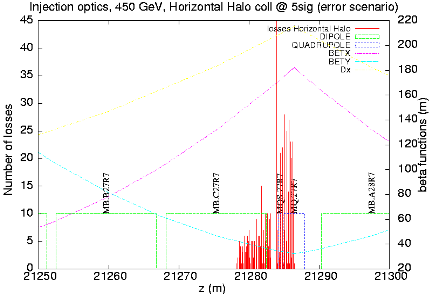
Top view of SSS cryostat

Original motivation (I)

L. Ponce, 2006, loss maps: Ch. Bracco, S. Redaelli, G. Robert-Demolaize

2. Position in the ARCS

- Example of topology of Loss (MQ27.R7)
- Peak before MQ at the shrinking vacuum pipe location (aperture limit effect)
- End of loss at the centre of the MQ (beam size effect)

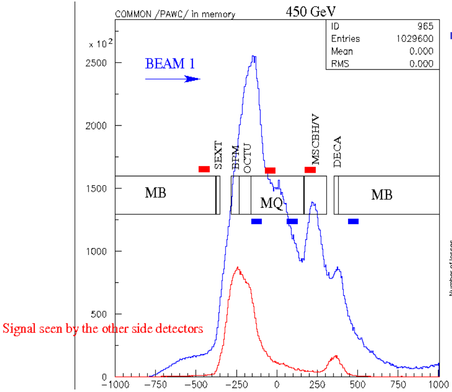


More simulation are needed to get better evidence (higher populated tertiary halo)

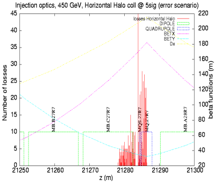
Original motivation (II)

L. Ponce, 2006, Geant3 simulations

“Integrated” signal seen by the BLMs



- Sum of the weighted contribution of all locations for realistic signal



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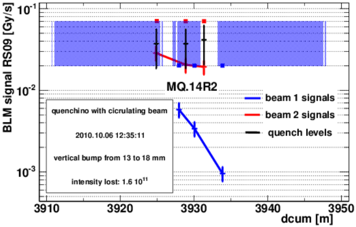
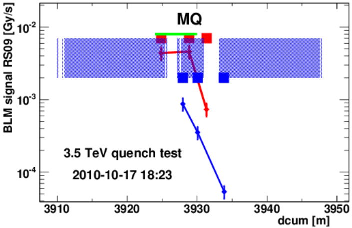
Loss shapes during quench tests

- beam 2 impacting
- 3-corrector bump used to generate loss
- this corresponds to assumed loss scenario
- MQ 14R3 quench 3 times at injection and once at 3.5 TeV (6s loss).





- **2-3 monitors always give high signal** (redundancy)
- absolute values of signals at quench found within factor 3 with respect to calculated

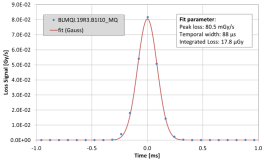
Unexpected loss scenario: UFOs

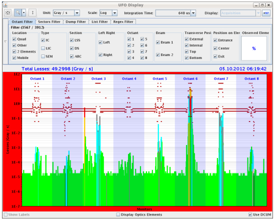
- UFO losses were not expected
- first observation reported A. Nordt July 2010 (MPP)
- localized losses lasting about 1 ms
- never quenched a magnet
- multiple beam dumps - mitigation: increase of BLM threholds by 5
- rare dumps still occure

  (2012.10.05: BLMQI.31L3.B1I10_MQ)
- a research program launched

  (UFO buster, MKI loss MDs, Frank simulations, Eduardo data digging, etc,

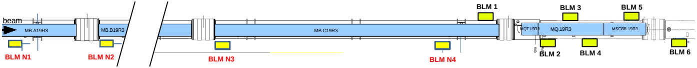
  see exhaustive Tobias' presentations)



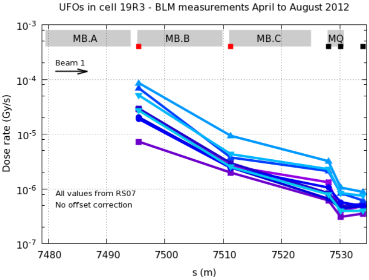


Observations in cell 19R3

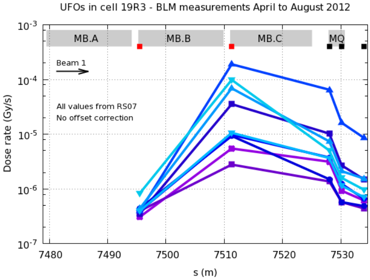
- Part of the program: installation of additional monitors in C19R3 where UFOs are more frequent (Chamonix 2012)
- This allows to conclude about distribution of UFOs within arc cell



- 2 classes of UFOs: max signal observed in MB.B and MB.C BLMs:



UFOs in MB.A

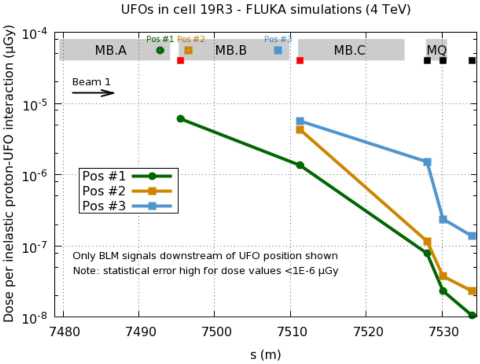


UFOs in MB.B

UFO distribution along cell

Conclusions from 19R3 study:

- **UFOs are distributed all along the cell**
- **UFO in MB might quench the magnet and BLM system will not prevent**



FLUKA simulations:

- Loss shapes reproduced for various assumed UFO locations.
- Only 2 out of 4 additional BLM shown as the most sensitive to UFOs.

Solutions to protect whole cell from UFO-generated quenches

The simplest solution: move one BLM from middle of MQ to the beginning of MB.B

- redundancy still on MQ
- covers all but first half of MB.B
- cheapest solution
- factor 50 between monitors on MQ and new location gained

The second solution: move one BLM and install additional BLM on MB.C

- covers whole cell
- about 800 new chambers must be produced...
- factor 5 between MQ monitors and second additional monitor gained

Putting it to the table

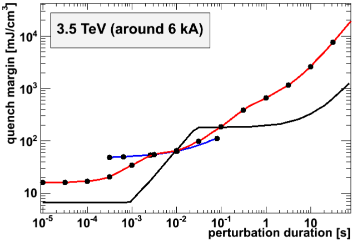
Gain with respect to current installation.

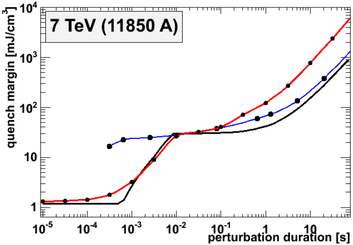
UFO location	BLM on MB.B	BLM on MB.C
MB.A	50	5
MB.B beginning	-	20
MB.B end	-	5

Table: Gain in signal with respect to current BLM installation (BLMs on MQ only) in case of UFO events localized in MB magnets.

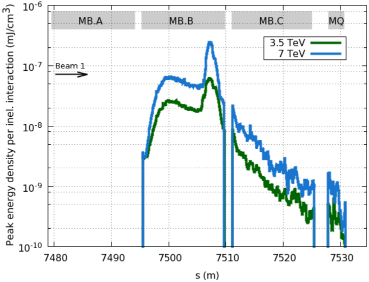
What to expect after LS1

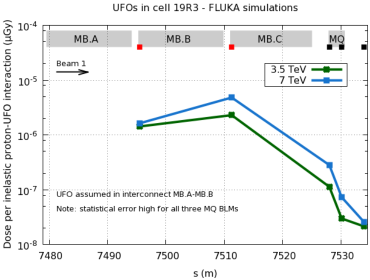
- deconditining of the machine (more UFOs at the beginning of the run)
- 25 ns beam - more UFOs expected
- energy increase to 6.5 or 7 TeV - quench level decrease
- comparison of Note44 algorithm and QP3 code
- might be factor 10 decrease in QL between 3.5 and 7 TeV (factor 5 might be lost!)
- milisecond quench test is very important





Threshold estimation





- 3.5 TeV, QL=30 mJ/cc,
  $T = 2 \cdot 10^{-12}[Gy]\frac{30mJ/cc}{5{\cdot}10^{-8}[mJ/cc]} = 1.2mGy$
- 7 TeV, QL=3 mJ/cc,
  $T = 4 \cdot 10^{-12}[Gy]\frac{3[mJ/cc]}{2{\cdot}10^{-7}[mJ/cc]} = 0.06mGy$
- currently assumed QL for BLMs on MQ: 1.3 mGy at 3.5 TeV (the same for UFOs and for previously assumed losses)

Conclusions

- BLMs should be reconfigured in order to protect arc dipoles from UFO-induced quenches.
- The simplest is to move one BLM/cell/beam from MQ to beginning of MB.B.
- Small impact on BLM reliability.
- This might still leave a part of MB.B unprotected from UFO-induced quenches.
- Other solutions require many additional monitors.
- **It won't protect from UFOs but will allow to run closer to the quench limit.**
- **MB circuits are more friagile than MQ ones, it makes a lot of sense to protect them from quenches.**