PRELIMINARY ANALYSIS OF QUENCH TEST

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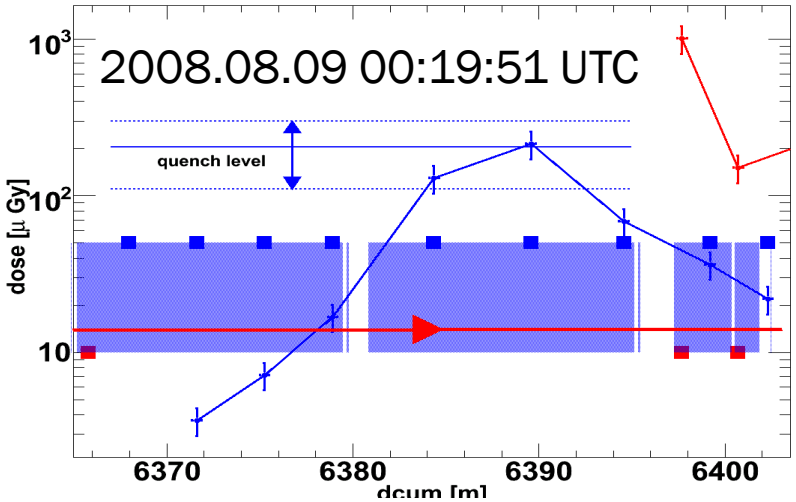
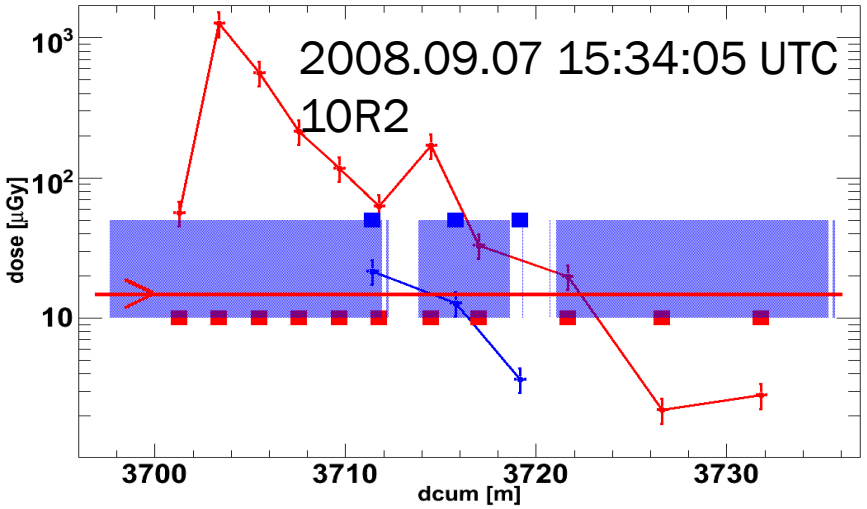
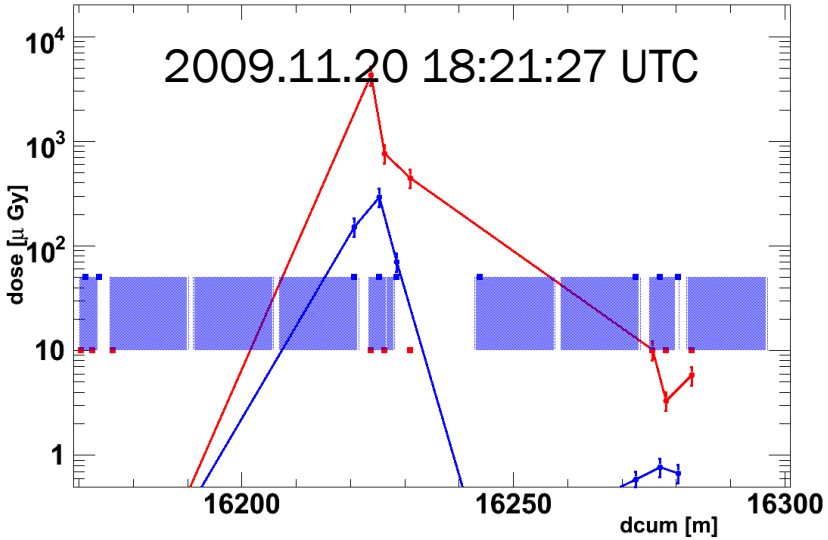
OUTLOOK

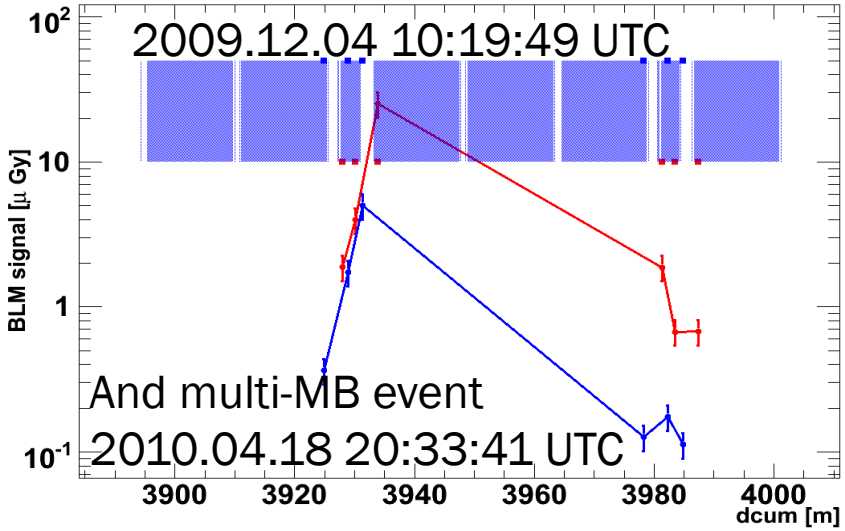
1. Quenches before September 2010 – reminder
2. “Golden” quenchino
3. MQ quench levels and Geant4 simulation status
4. MQ present thresholds
5. MQ fast quench test
6. MQ/MB slow quench test at 450 GeV
7. Test at 3.5 TeV
8. What have we learned about quench levels?
9. What else do we need to know?

QUENCHES BEFORE SEPTEMBER 2010







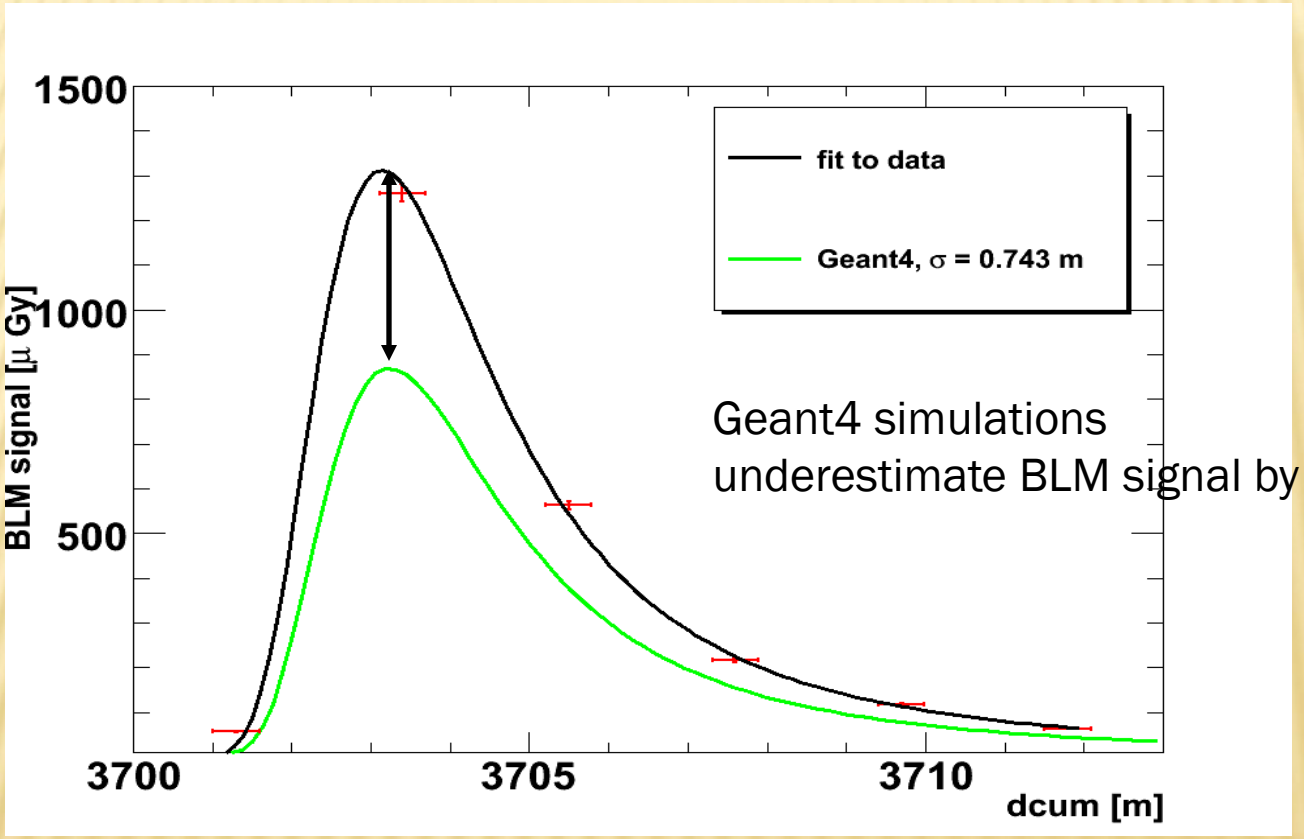


OLD QUENCHES: SUMMARY

- All MB quenchinos
- All, except one, vertical losses
- All at injection energy
- All within the first turn
- All beam 1

for fast vertical loss at injection energy it is easier to produce quenchino in MB than in MQ

GOLDEN QUENCHINO



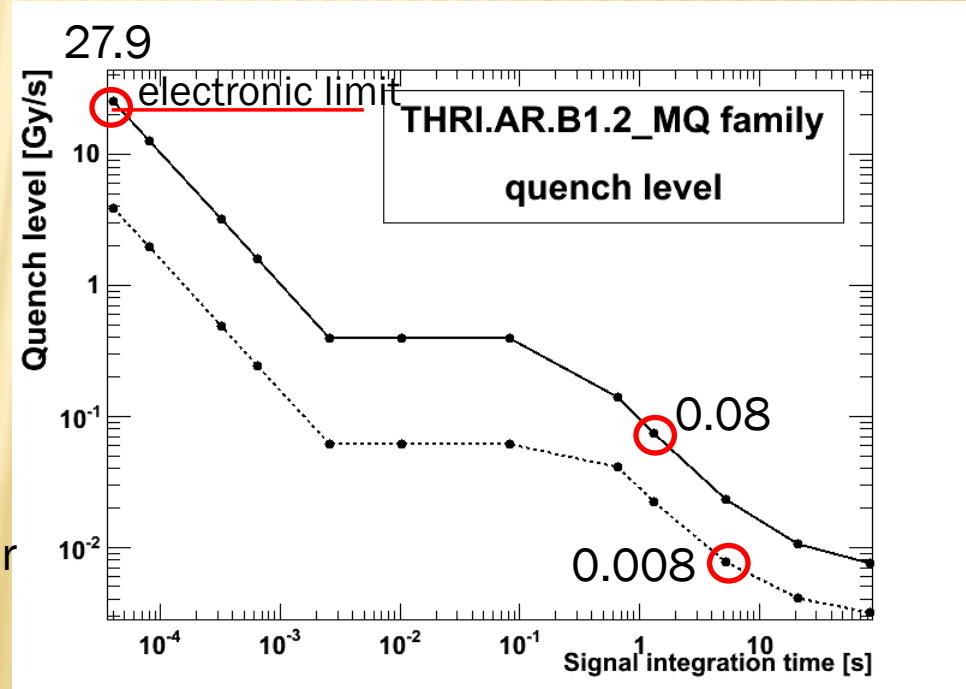
Geant4 simulations underestimate BLM signal by 50%

PRESENT MQ THRESHOLDS

- Based on Geant4 simulations:
  - Agnieszka Priebe – geometry
  - Christoph Kurfuerst – simulation and threshold calculation
- Thresholds based on horizontal loss on defocusing quadrupole

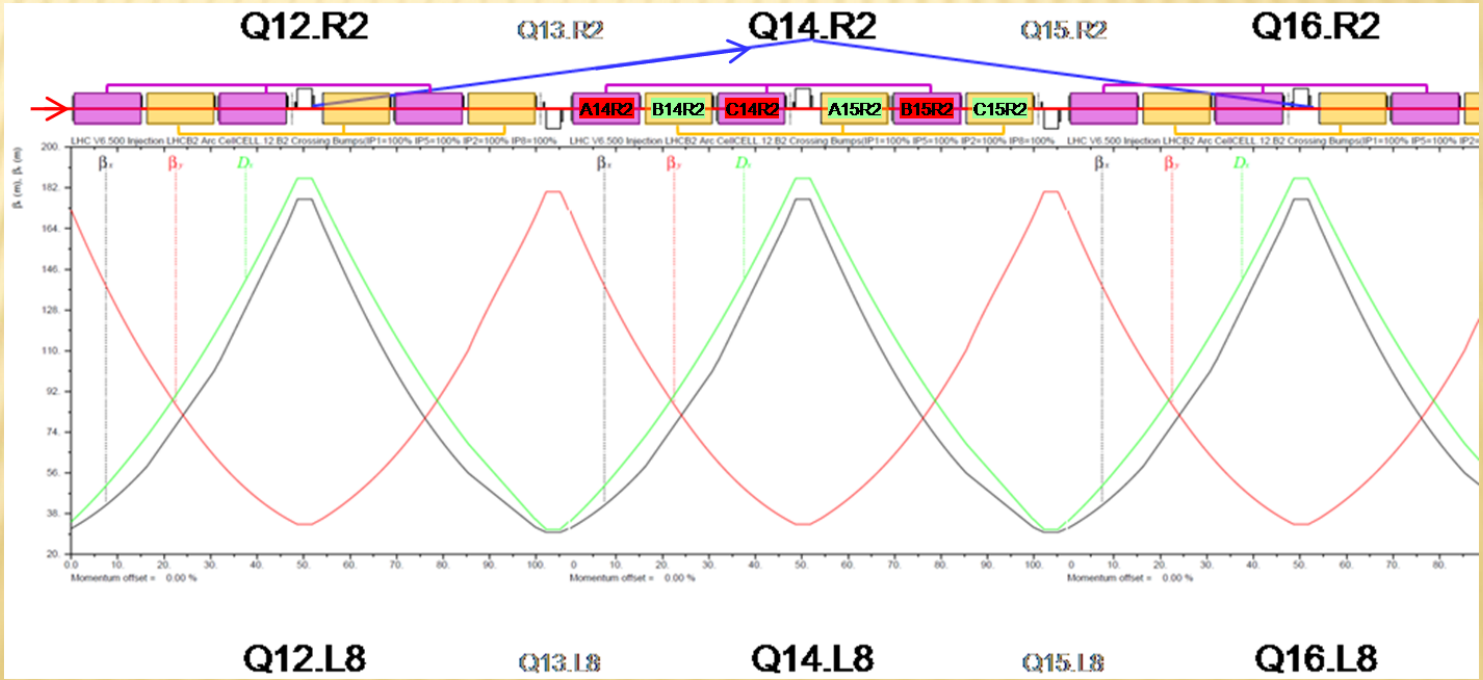
$$T = Q_{BLM} \frac{QL}{E_D}$$

In LSA now there are some inconsistencies in the way thresholds are calculated for BLM1 and BLM2



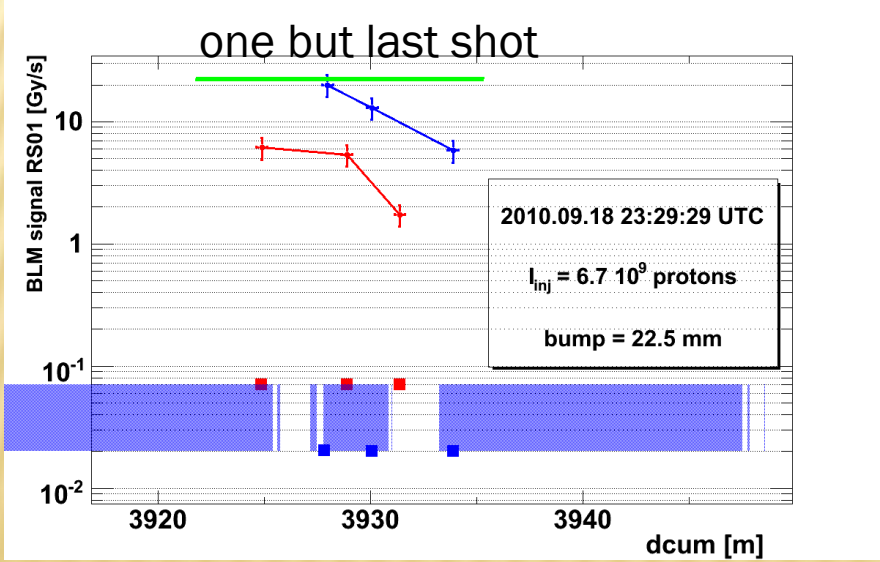
TEST CAMPAGNE FALL 2010

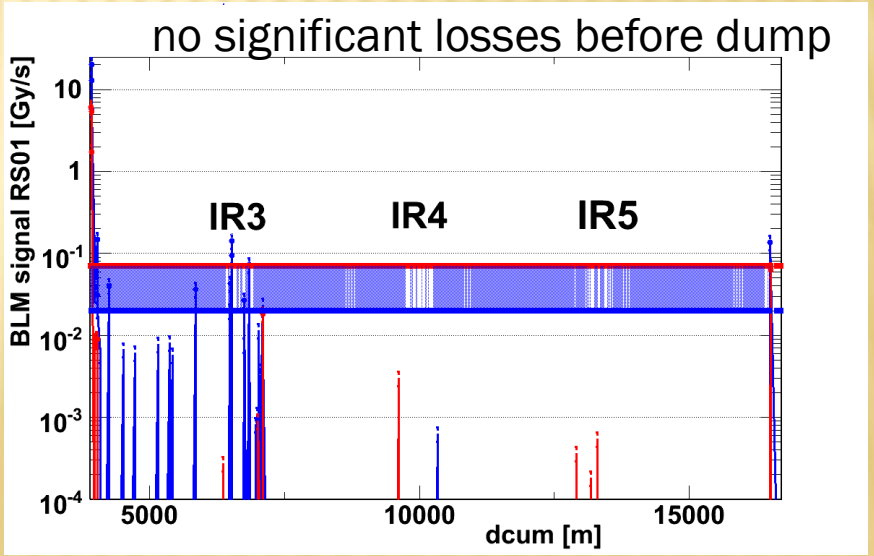
- 450 GeV, 40 µs
- 450 GeV, about 1 s
- 3.5 TeV, about 10 s



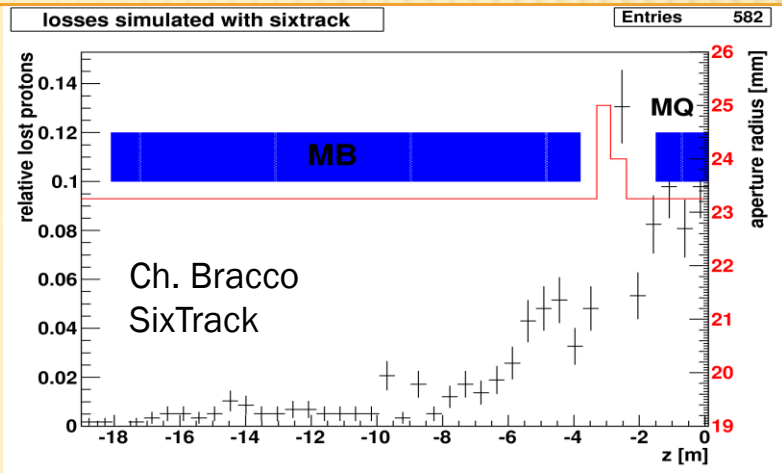
450 GeV, FAST LOSS

- September 18/19
- Horizontal bump, about 50 injections, size 19-24.3 mm, intensity 0.3-0.8 · 10^{10} protons
- No quench, but QPS crate get too much radiation – reset needed





450 GeV, FAST LOSS (II)



- Let's try some math for this event:
- $I_{inj} = 6.7 \cdot 10^9$ protons
- $I_{dump} = 1.2 \cdot 10^9$ protons
- BLM1 = 2 mGy = $2 \cdot 10^9$ protons
- BLM2 = 0.88 mGy = $1.9 \cdot 10^9$ protons
- I_{inj}-I_{dump} = $5.5 \cdot 10^9$ protons
- BLM1+BLM2 = $3.9 \cdot 10^9$ protons
- Missing $1.6 \cdot 10^9$ protons:
  - leak from BLM coverage, most likely in upstream MB – there is correlation between the size of bump and fraction of "leaking" protons
  - simulations can be wrong

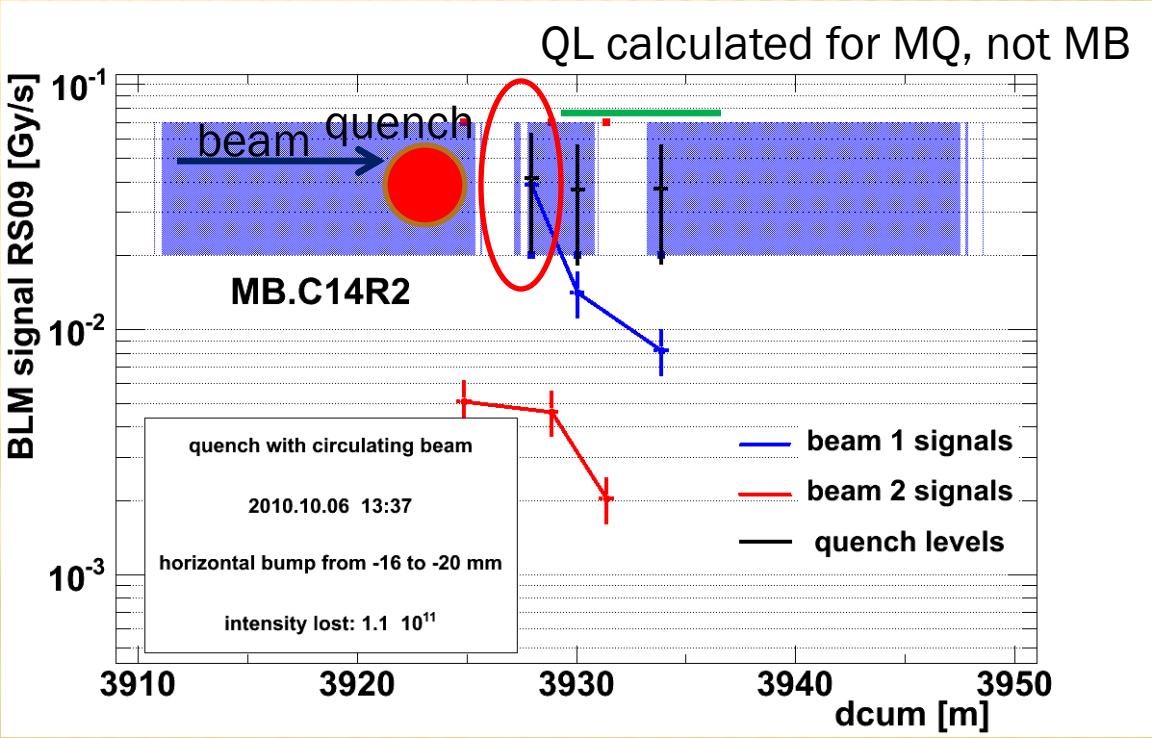
	Calibration
BLM1	9.8E-13 Gy/proton
BLM2	4.6E-13 Gy/proton

$(I_{inj}-I_{dump})/(BLM1+BLM2) = 1.4$

450 GeV, 1s –LOSS HORIZONTAL

- October 6th, horizontal bump, increasing from -16 to -20 mm
- Upstream MB quenched
- No signal on MQ

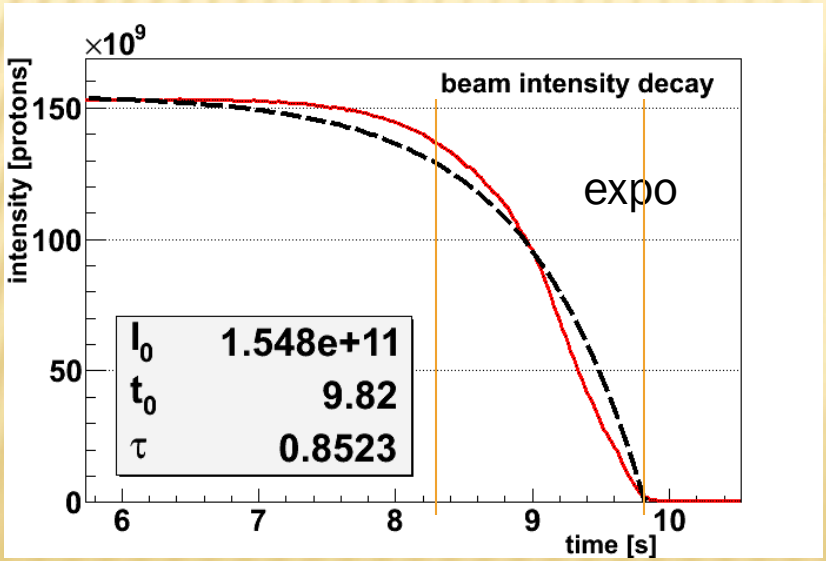
RS09 = 1.31 s
Signal at quench = 0.039 Gy/s
Theoretical Quench Level on BLM1= 0.041 Gy/s

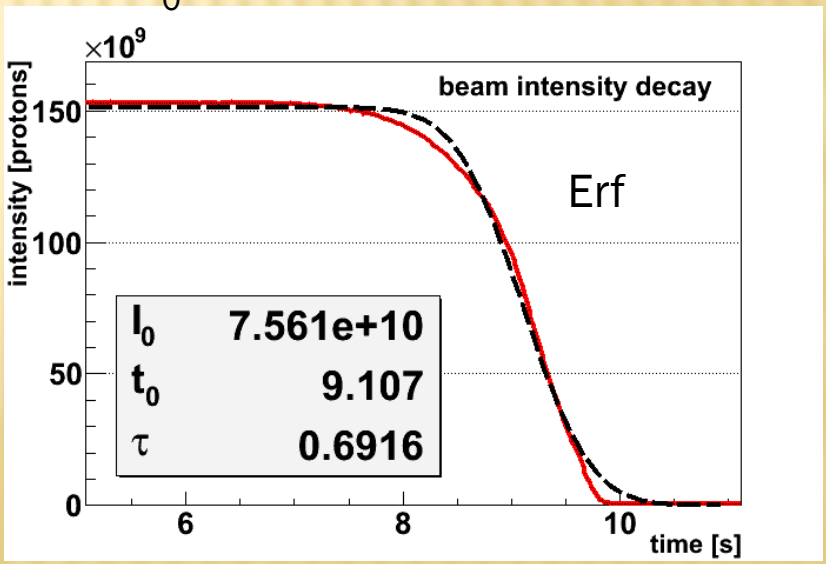


450 GeV, 1s –LOSS VERTICAL

- October 6th, vertical bump, increasing from -13 to -18 mm
- We have done vertical because beam 1 was unavailable
- MQ developed resistive zone, splice QPS dumped the current, quench heaters did not fire.
- Beam decay:

Loss of 90% of beam from 0.9 I_0 to 0: **1.55 s**

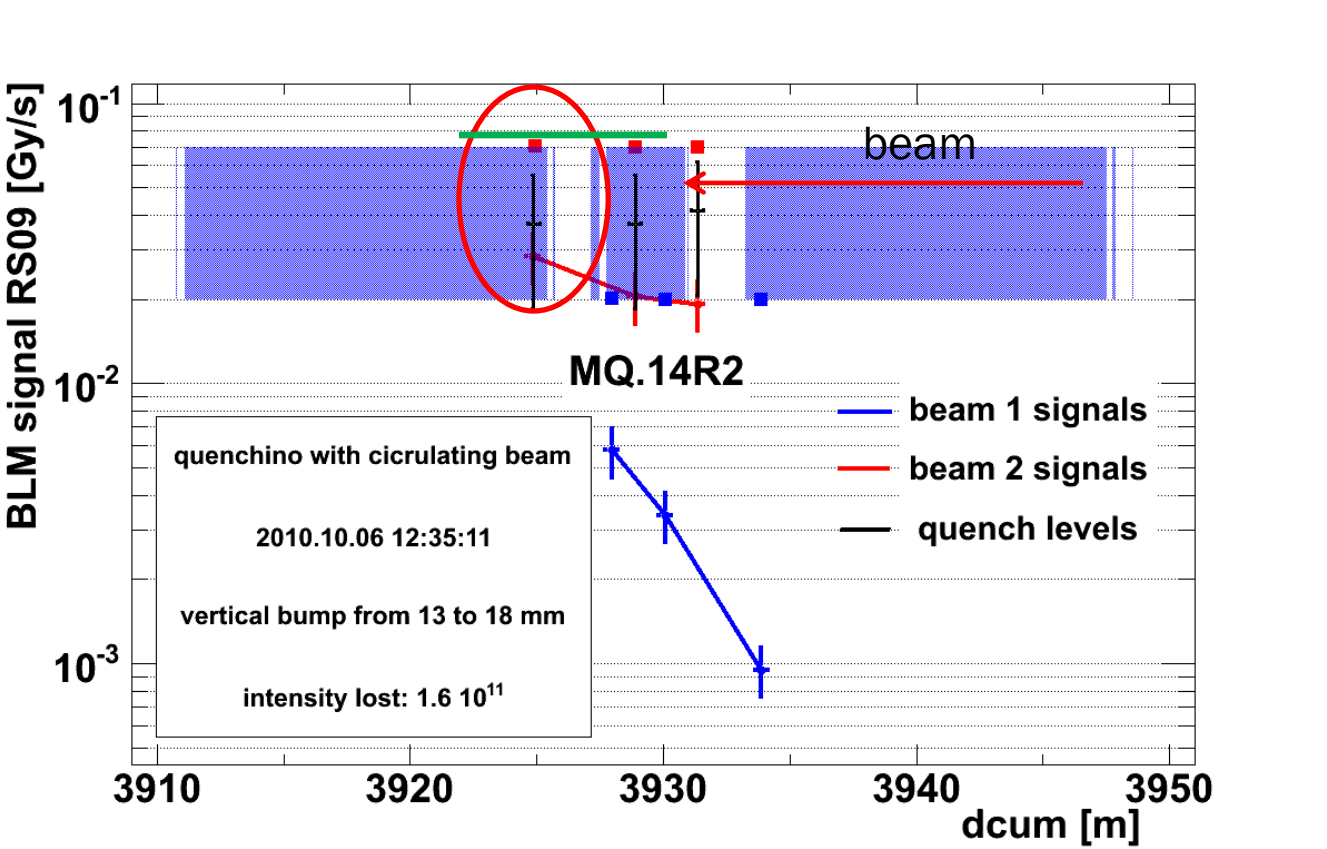




450 GeV, 1s –LOSS VERTICAL (II)

RS09 = 1.31 s
Signal at quench(ino) = 0.028 Gy/s
Theoretical Quench Level = 0.080 Gy/s

we were too optimstic by factor 2.9



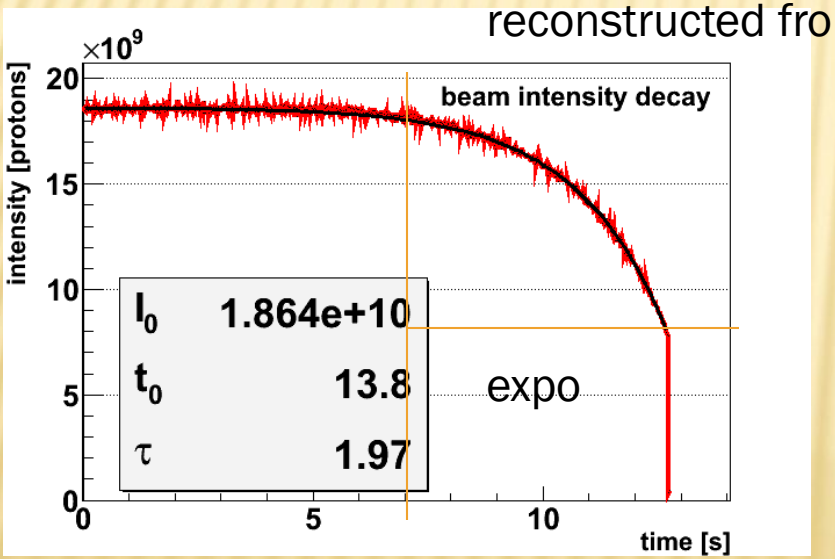
QUENCH OR QUENCHINO ?

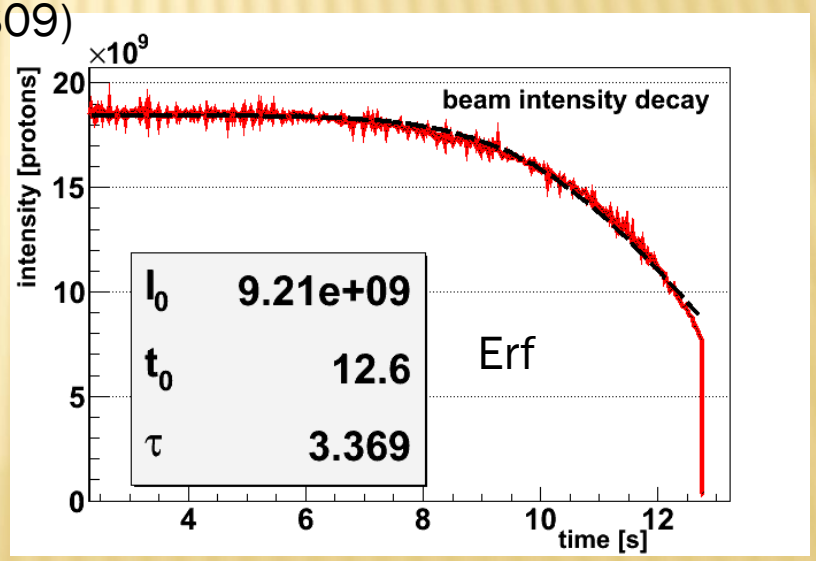
From Knud Dahlerup-Petersen

3.5 TeV, 10 s LOSS

- October 17th, vertical bump (as before) increasing from 15 to 21 mm
- MQ quenched (Quench heaters fired)
- Beam decay:

90% of the intensity which were not dumped were lost during 5.6 s (RS10: 5.2 s, but we do not log it, but it can be reconstructed from RS09)

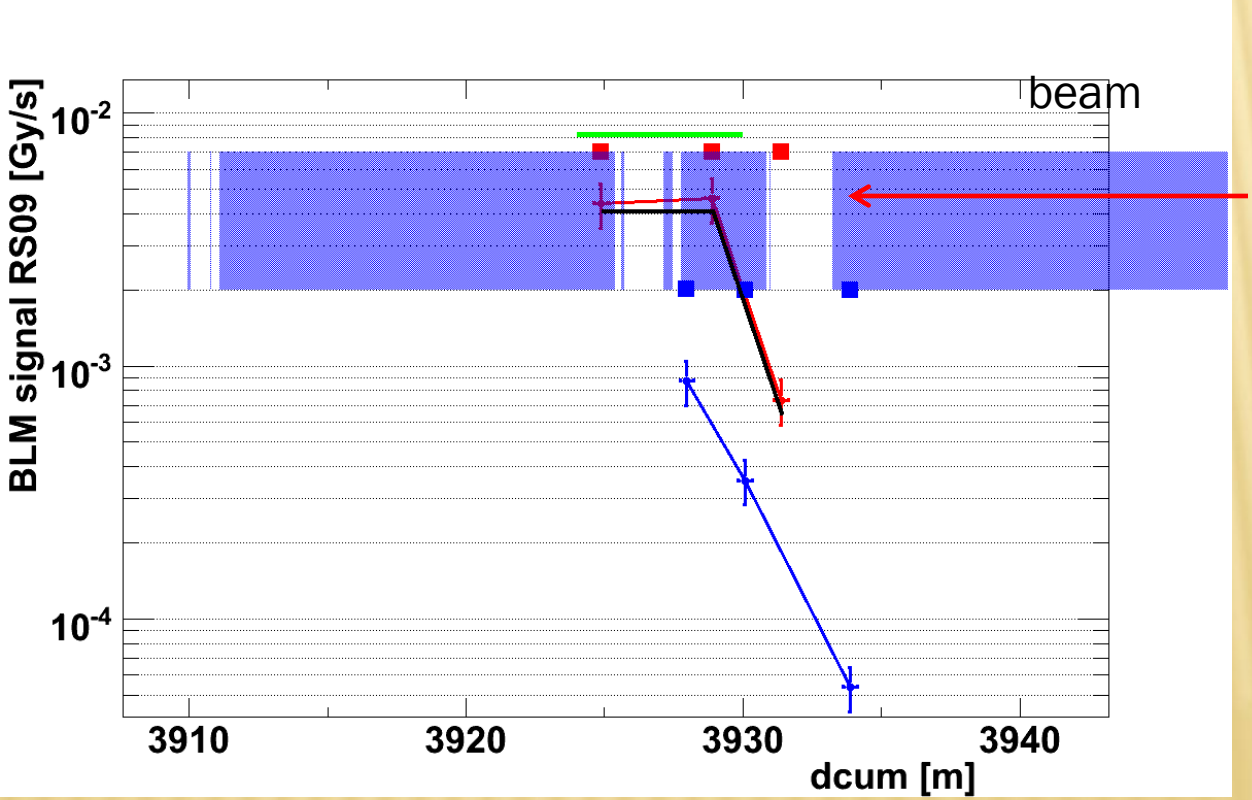




3.5 TeV, 10 s LOSS (II)

RS10: 5.2 s
Signal at quench (estimated from RS09): 0.0041 Gy/s
Theoretical Quench Level = 0.0082 Gy/s

we are too optimistic by factor 2

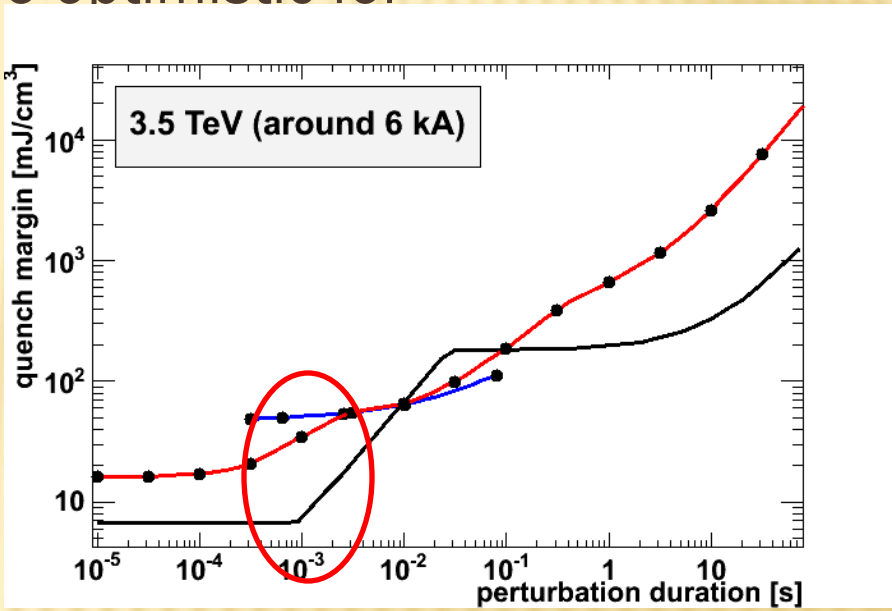


CONCLUSIONS AND PLANS

- Fast transient quench test at 450 GeV – not conclusive, no quench, QL expected in BLM electronic saturation.
- 1 s quench test at 450 GeV – threshold too optimistic by about factor 3.
- 5 s quench test at 3.5 TeV – threshold too optimistic by factor 2.
- This timescales are not limiting us – we need to investigate 1 ms timescale – wire scanner test

CONCLUSIONS AND PLANS (II)

- QP3 code (Arjan Verweij) – more optimistic for UFO timescale
- we continue analysis:
  - Where the protons went?
  - Geant4 with focusing quadrupole
  - Exercise QP3 code



- I'd prefere not to change the thresholds yet – Xmass shutdown

EXTRA SLIDES

MISSING PROTONS VS BUMP SIZE