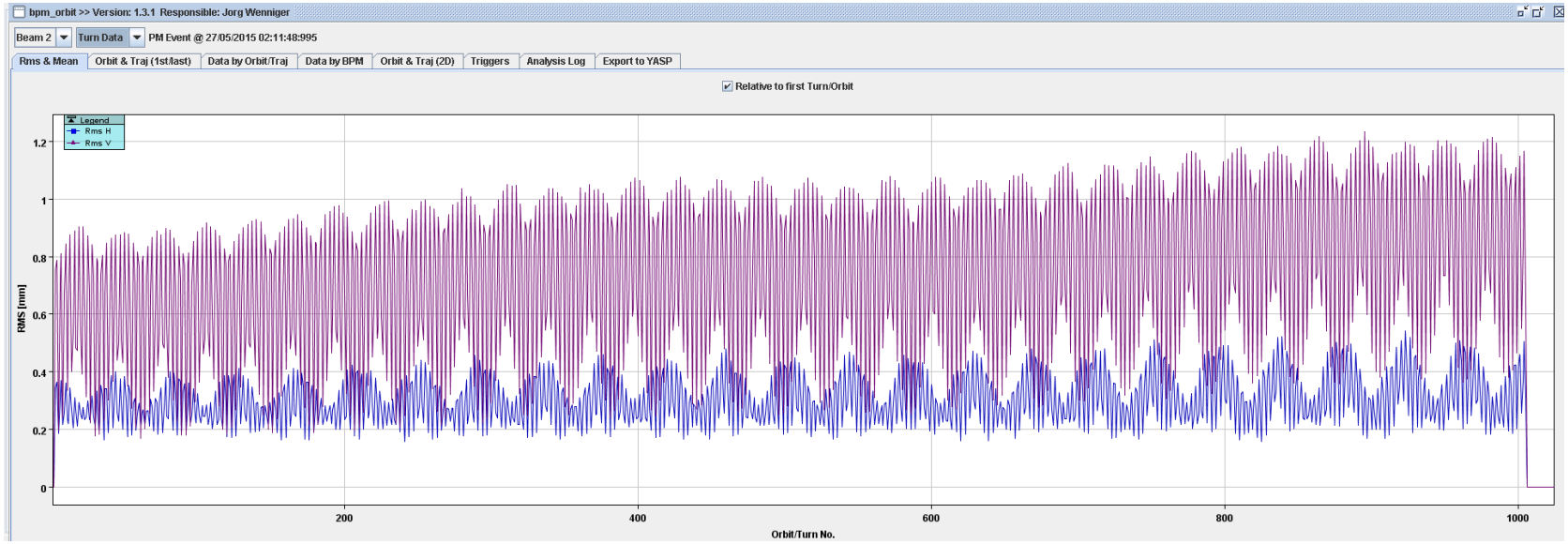
Triplet Losses on 27.05.2015 vs. New Triplet BLM Thresholds

MPP, 14.08.2015

B. Auchmann based on MAD-X event analysis by V. Chetvertkova

What happened (V. Chetvertkova).

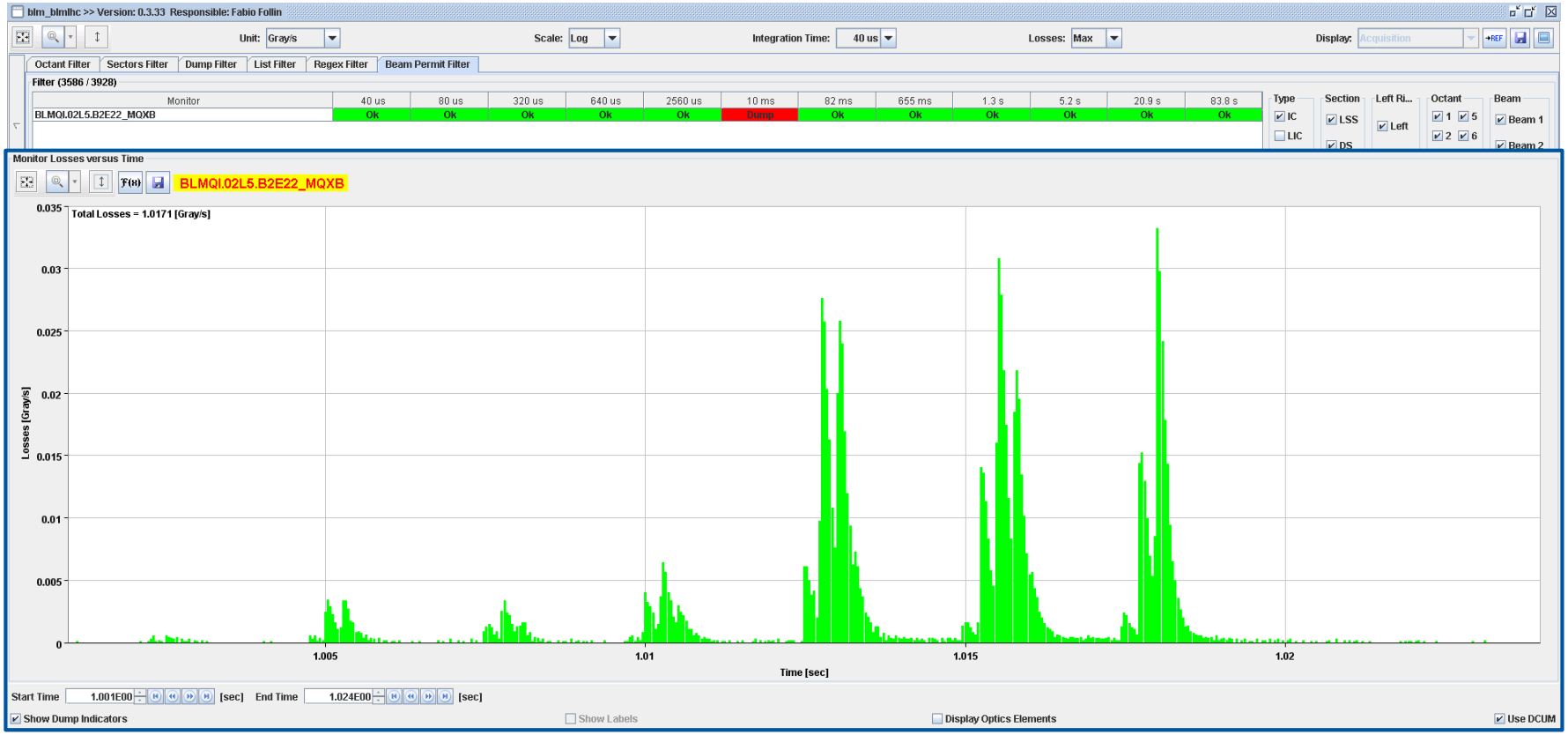
- Beams were dumped due to 10ms RS by a BLM at IP5: BLMQI.02L5.B2E22_MQXB
  - Beam losses were observed during ~15ms, with peaks every ~3ms
- BPM ORBIT:



- Frequency of the AC dipole trimmed too close to the tune value

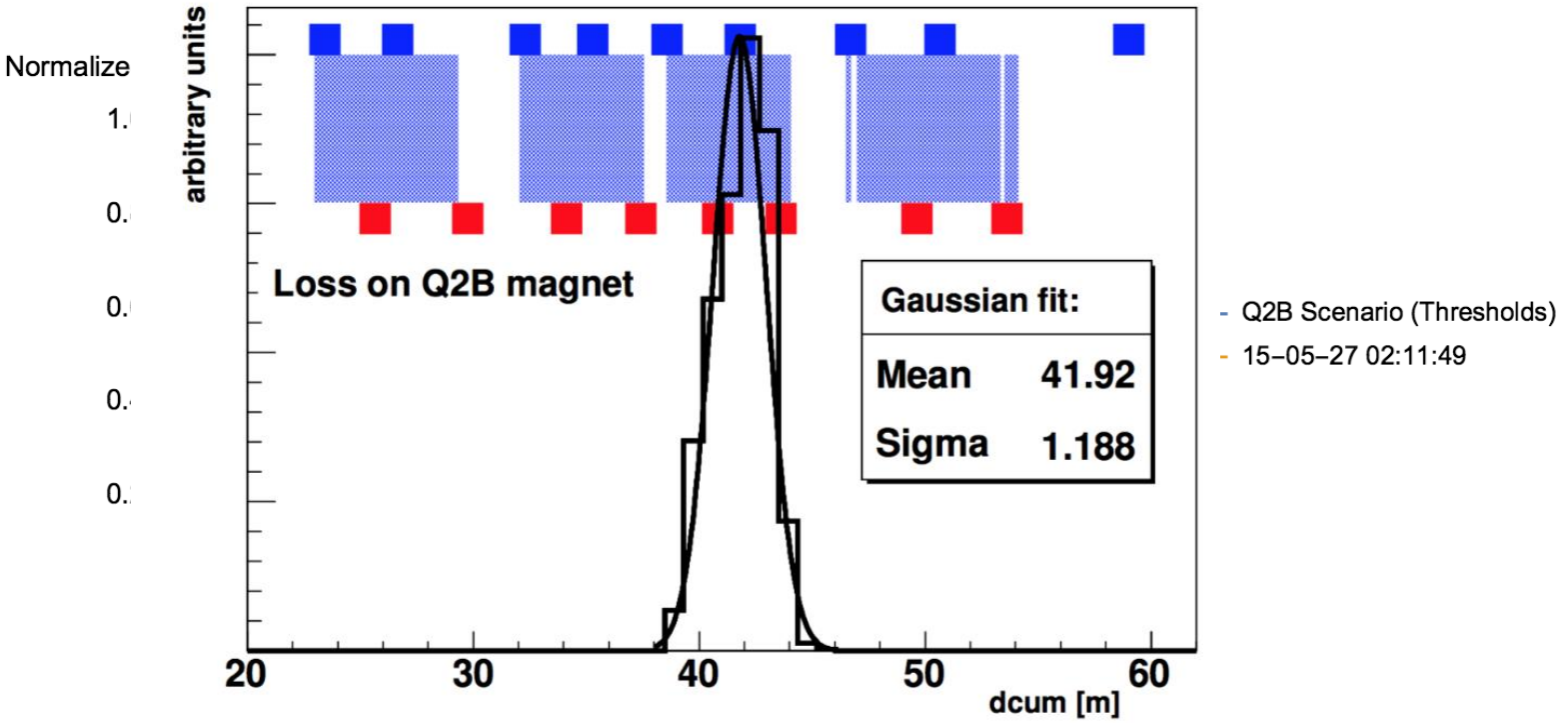
BLM Data

- BLMQI.02L5.B2E22_MQXB dumped the beam in RS6 (10 ms).



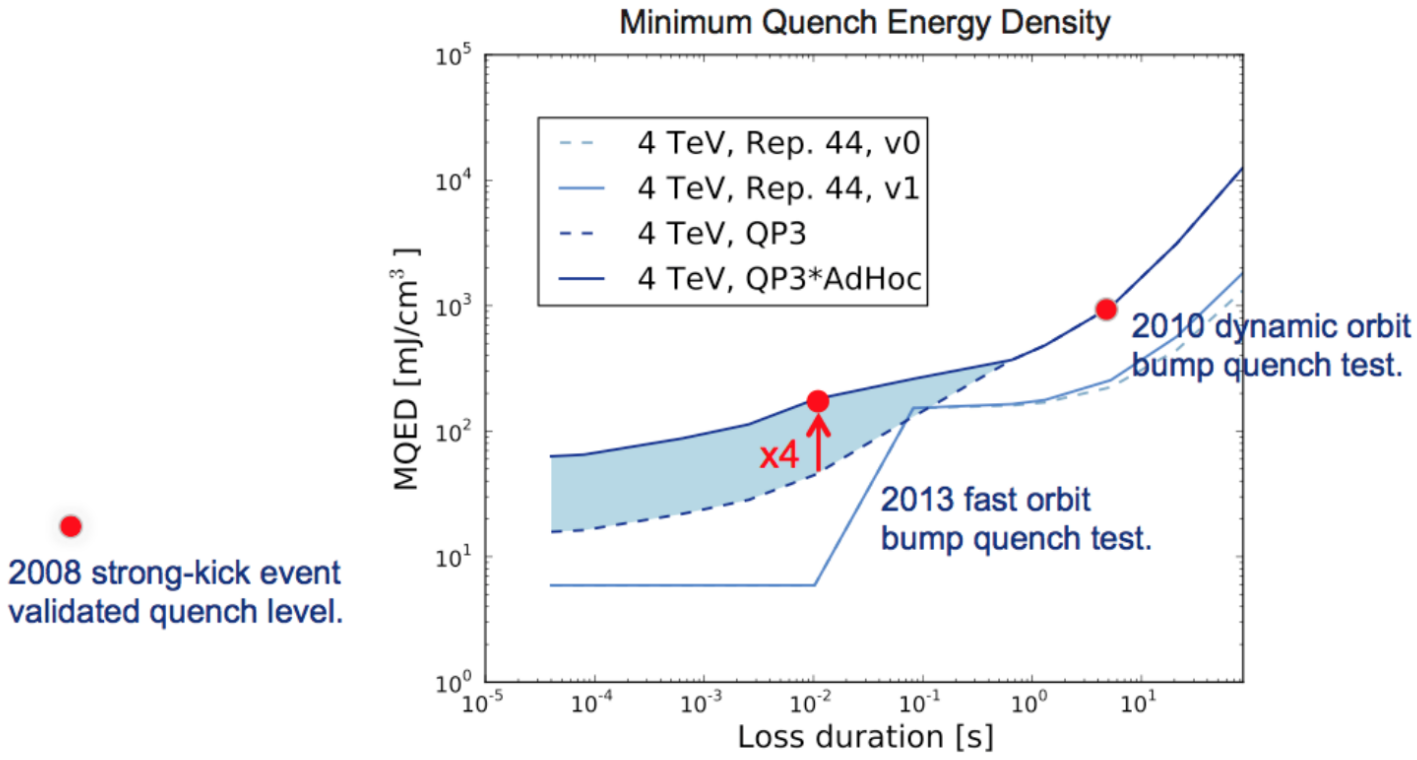
Comparison of Scenarios

- During TS1 (after the event), triplet thresholds were updated.
- The (old and new) thresholds are set for the so-called Q2B scenario, i.e., the loss peak is inside the Q2b magnet.
- The loss event of 27.05. had the peak in between Q2a and Q2b.
- The assumed BLM sensitivity is therefore not accurate. Thresholds are likely lower than they would have to be for this scenario.



Old vs. New Quench Levels

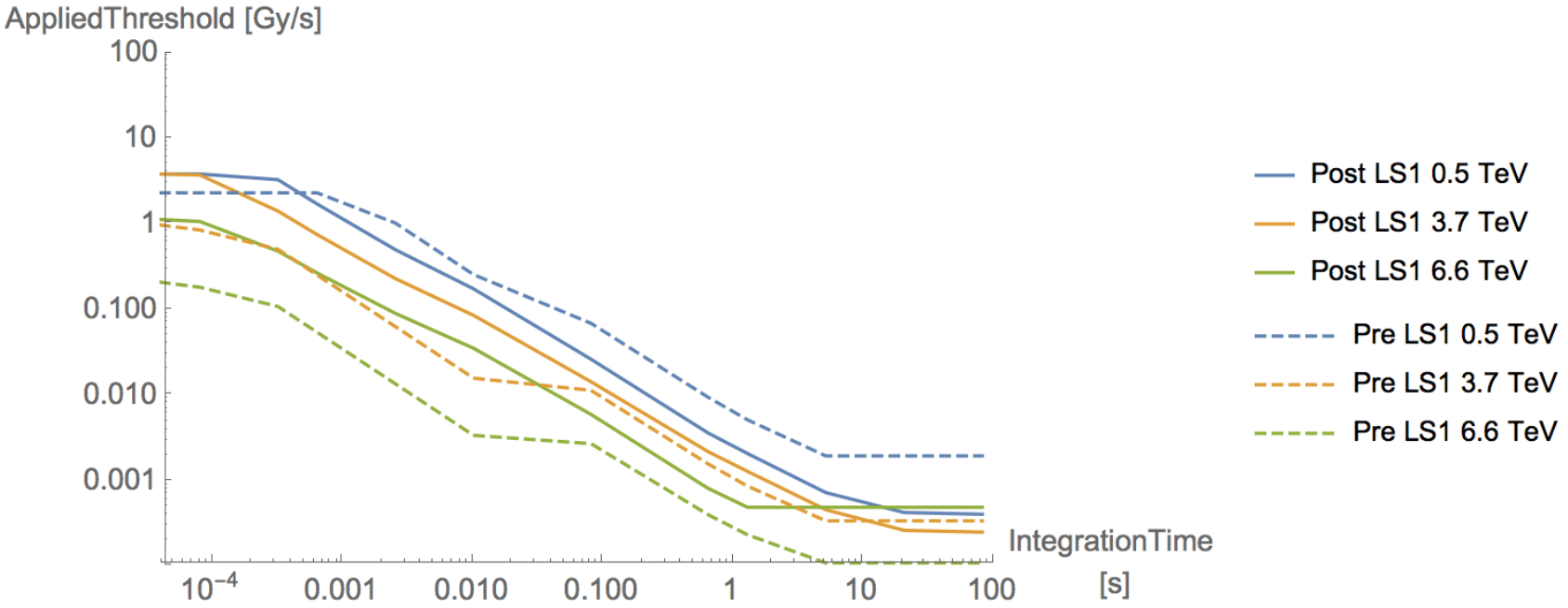
- For the 10-ms RS the difference between Note-44-based and QP3-based quench levels is >10x.
- (Note, the below graph is for MB, the effect is similar for MQXB.)



Old vs. New Thresholds

- The peak signal in RS 6 was 0.0036 Gy/s.
- The (old) threshold was 0.0034 Gy/s (just tripped, that is why no other monitor tripped.)
- The new applied threshold will be 0.035 Gy/s.
- The instability could have gone on a bit longer before we would have tripped. Could we prevent a quench?

Old vs. New Thresholds



$$\mathrm{BLMSignal@Quench}(E,t) = \frac{\mathrm{BLMResponse}(E,t) * \mathrm{QuenchLevel}(E,t)}{\mathrm{EnergyDeposit}(E,t)}$$

$$\mathrm{MasterThreshold}(E,t) = N * \mathrm{BLMSignal@Quench}(E,t) * \mathrm{AdHoc}(E,t)$$

$$\mathrm{AppliedThreshold}(E,t) = \mathrm{MonitorFactor} * \mathrm{MasterThreshold}(E,t)$$

What if the losses were 10x stronger?

QuenchLevels are too optimistic.

- The UFO-induced quench teaches us that the assumed QuenchLevel is likely 10-30% too high for *single loss peaks*.
- The ULO-induced quenches teach us that for *multiple loss peaks* QuenchLevels need to be reduced (~50-60%).

MonitorFactor is pessimistic.

- The current MonitorFactor in the triplets is 0.167 (assumed BLMSignal@Quench is reached at MonitorFactor 0.333).

BLMResponse is pessimistic.

- The thresholds assume a lower sensitivity.

Therefore:

- We should be protected from quenches of MQXB with the new thresholds if the same scenario occurs, but 10x stronger.

Conclusion

- If this scenario is a likely loss scenario,
  - it should be studied with FLUKA and replace the Q2B scenario.
  - QuenchLevels should be reduced to account for multiple loss peaks.
  - Also the corrector magnets should be considered for quench protection.
- In the meantime we are certainly protected from damage and likely from quenches.