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Proposal for post-LS1 thresholds in the arcs

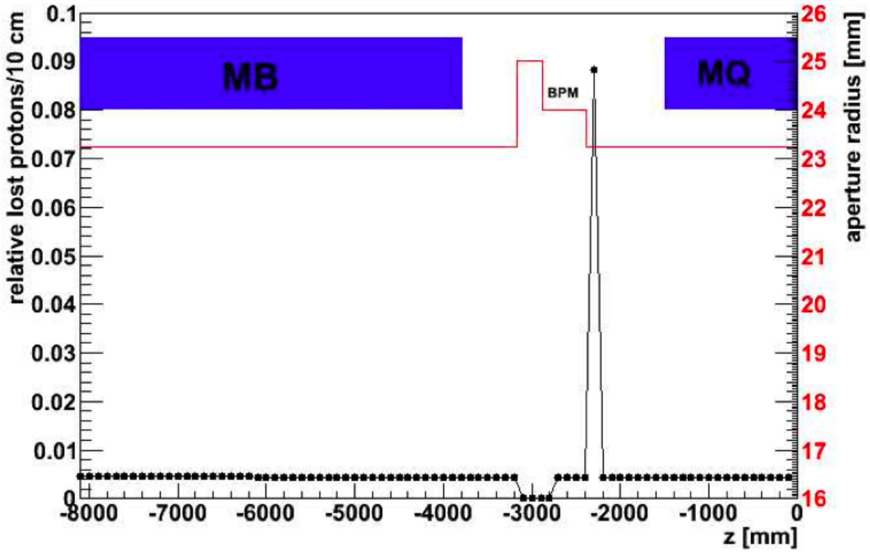
Assumed BLM signal at quench

- The assumed signal at quench is composed of three input factors:

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

Startup strategy

- Thresholds set for orbit-bump scenario in MQs (largest beta-function).
- BLM locations based on L. Ponce calculations.
- BLM thresholds based on C. Kurfürst diploma thesis.
- Quench levels of Report 44 and D. Bocian studies.



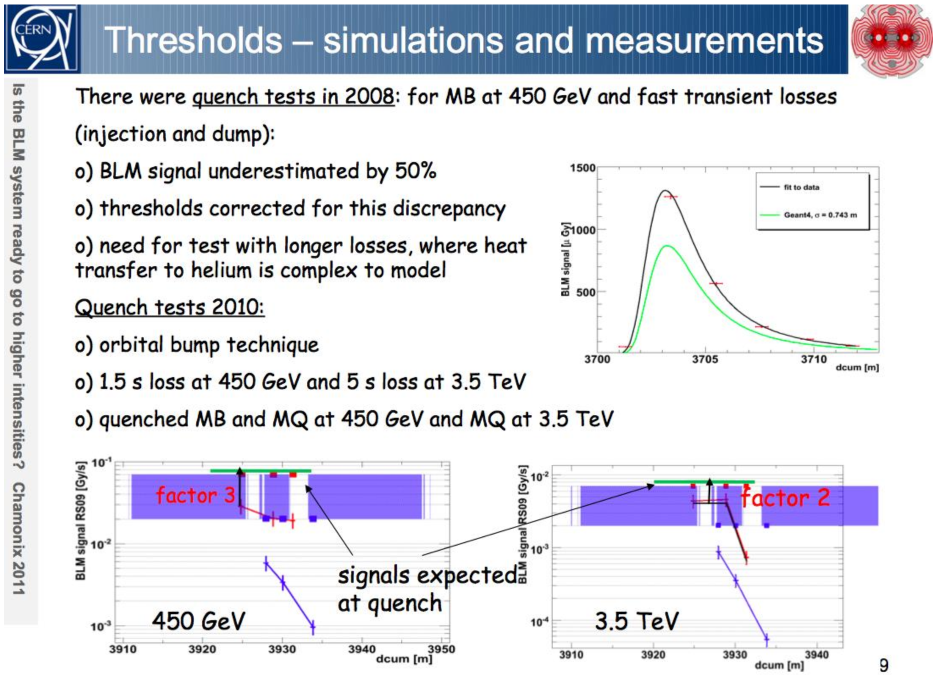
Pre-LS1 adjustments

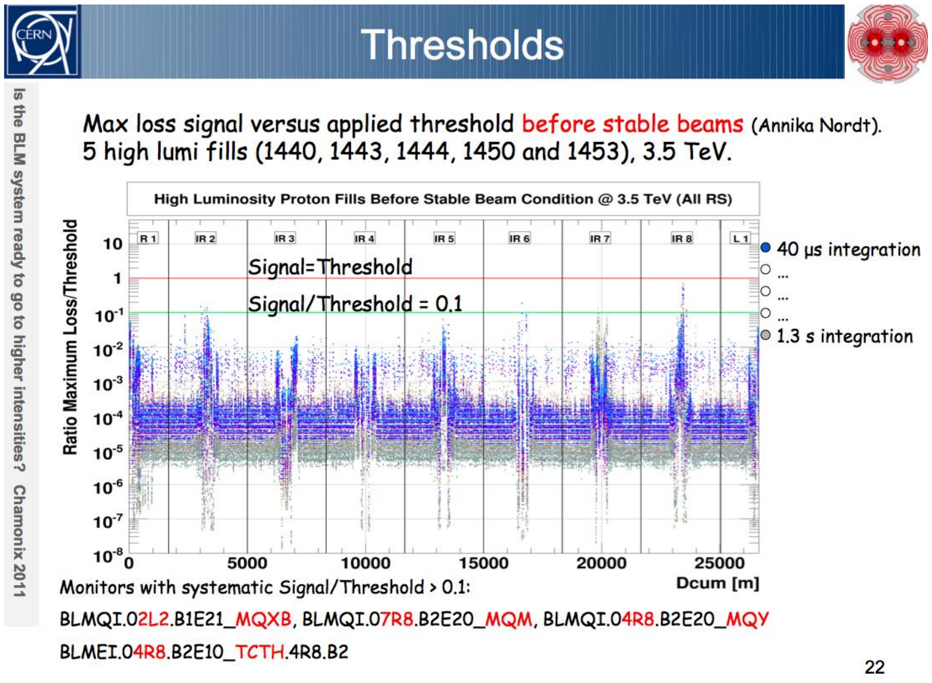
- Analysis of initial BIQ events (Note 422).
  - MQ position 1:
    - Kurfürst scenario for BLMResponse and EnergyDeposit.
  - MQ position 2&3:
    - Kurfürst scenario for BLMResponse.
    - Note 422 scenario for EnergyDeposit.
- Max. BLM signals observed during 5 High-Lumi fills @ 3.5 TeV
  - BLM thresholds increased by factor 3 in short running sums.
- UFO events without quench.
  - BLM thresholds increased by factor of 5 in ms-range.
- Dynamic orbit-bump QT.
  - BLM thresholds reduced by factor 1/3 in long running sums.

- These 3 corrections were used for all magnet types.

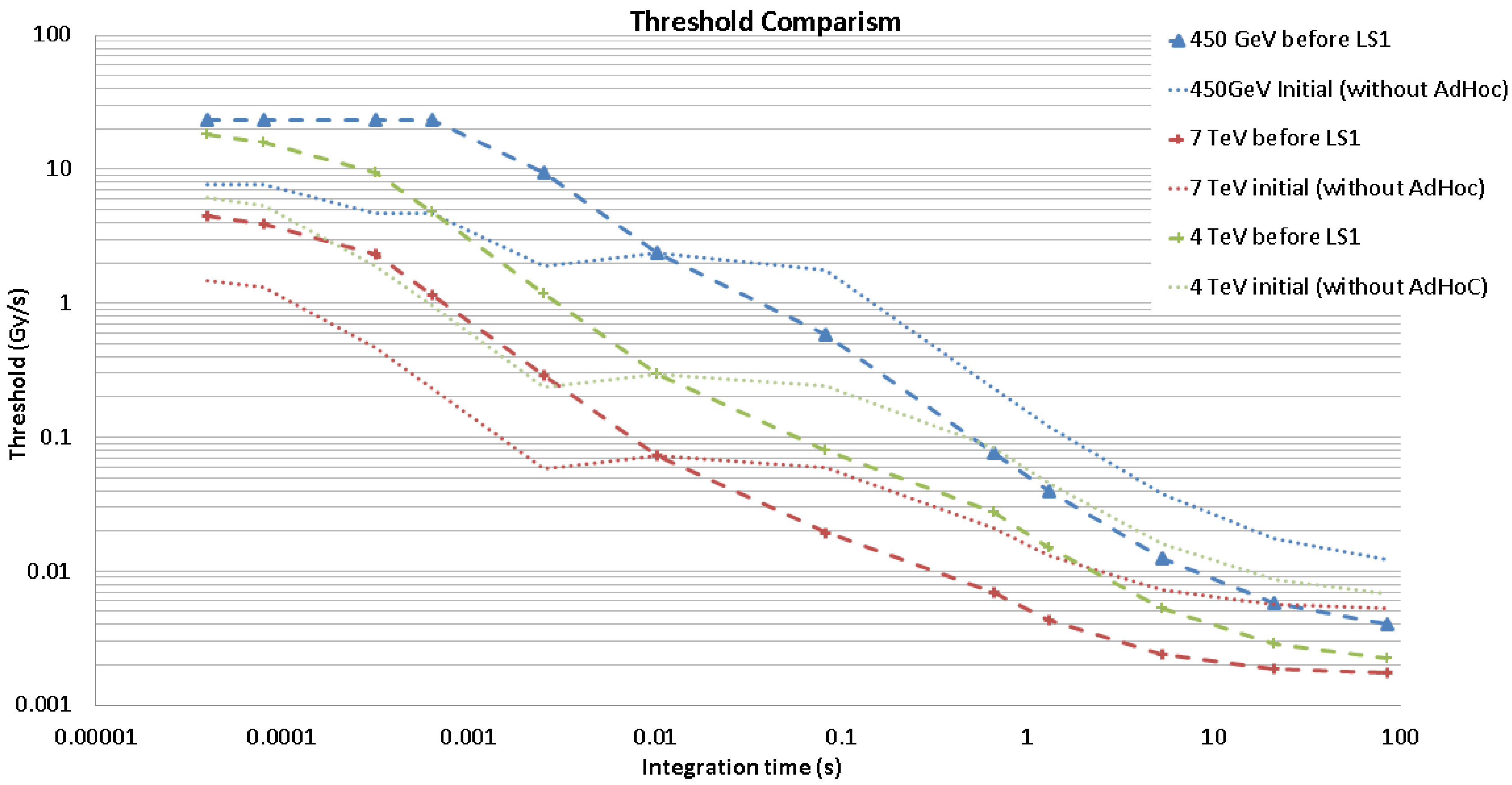
Pre-LS1 adjustments

- Slides by M. Sapinski, Chamonix 2011.





Pre LS1 Ad-Hoc Factors

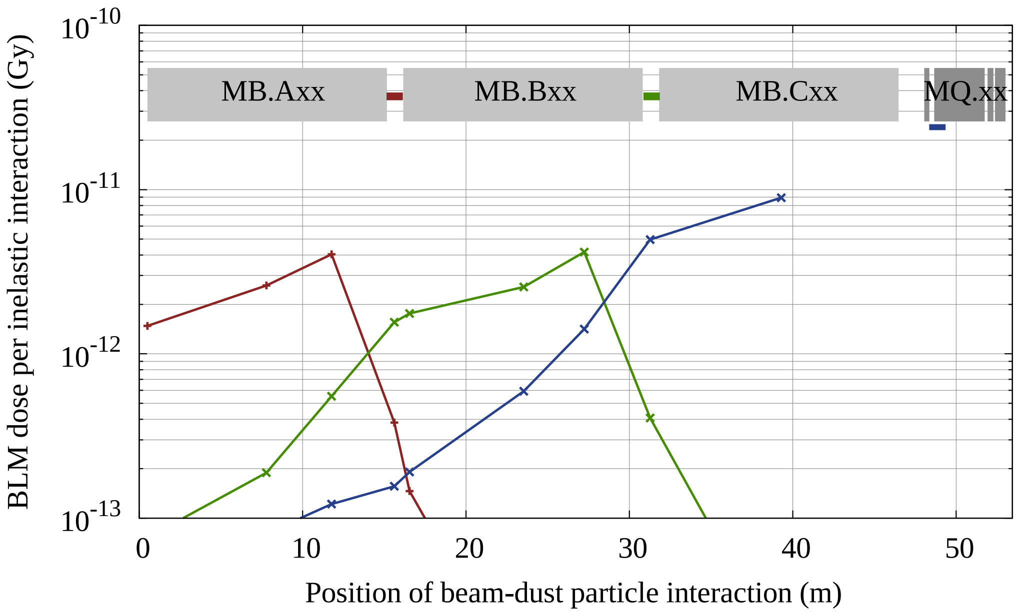


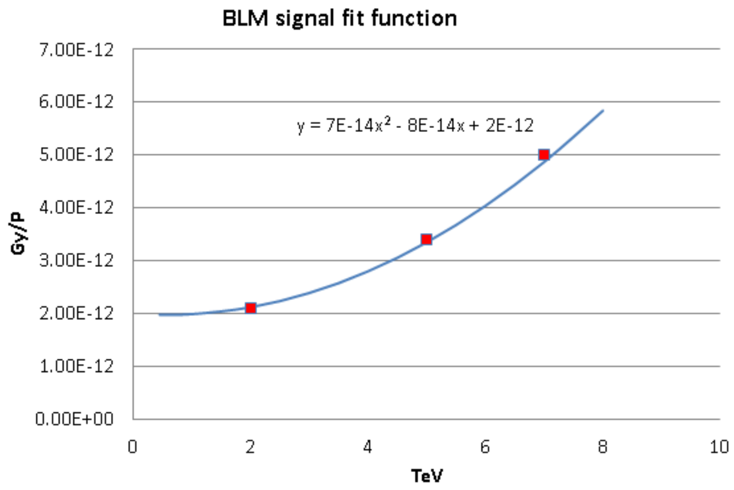
Post LS1 Arc Strategy Proposal

- The most likely scenario is U.F.O.
- The orbit bump scenario is extremely unlikely.
- For long integration times, the detection of a gas leak, albeit unlikely, could be of interest! (Gauges are far apart in the arcs).
- Therefore we propose to:
  - Discard orbit-bump scenario all together.
  - Use U.F.O. scenario up to RS06 (0.01 s).
  - Use gas-leak scenario for RS07-RS12. (FLUKA simulations running!)

The FLUKA U.F.O. Scenario

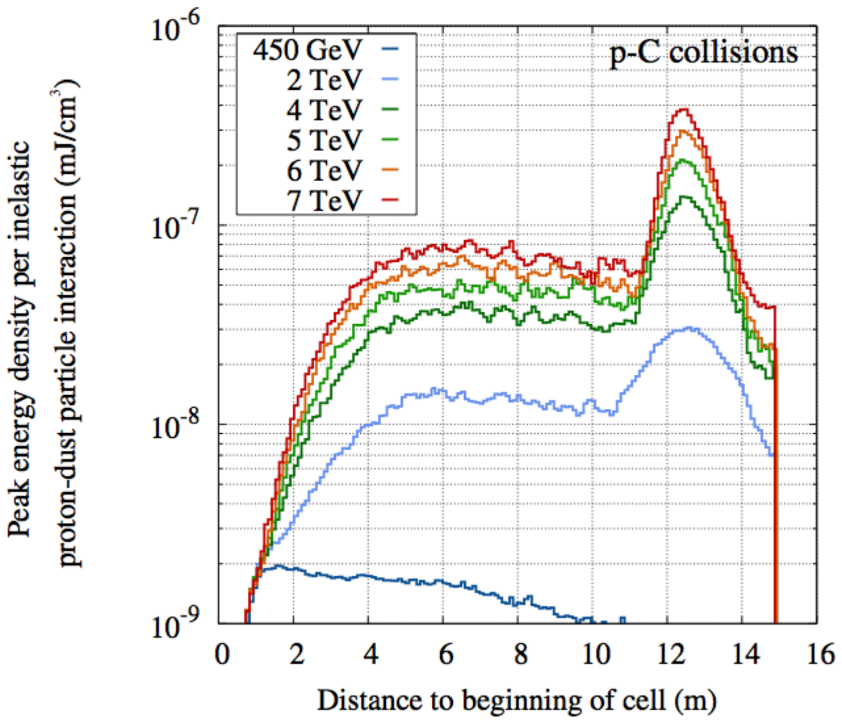
- All data by A. Lechner.
- Collision of proton with carbon-dust particle.

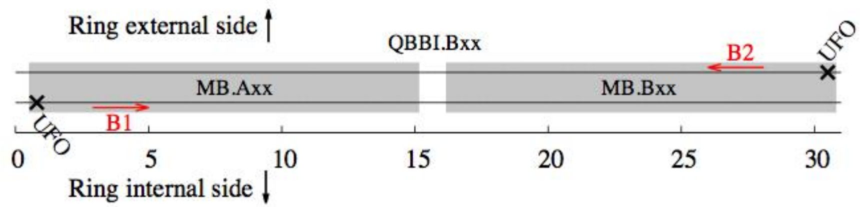




The FLUKA U.F.O. Scenario

- Energy deposition for p-C collsion at the beginning of an MB.





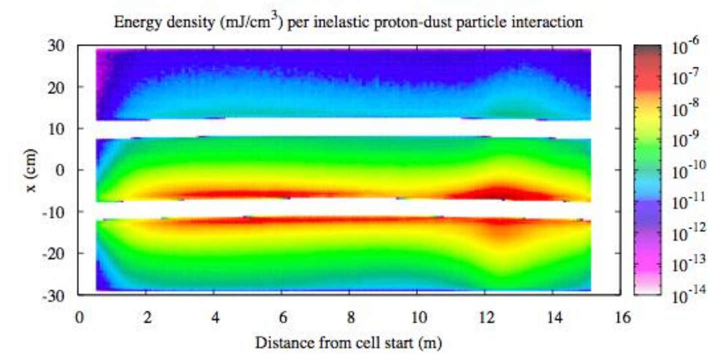
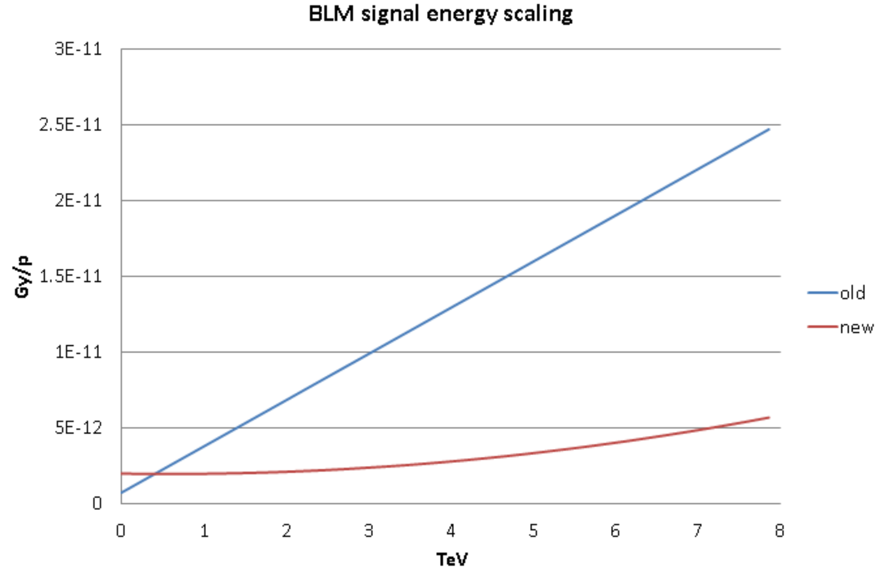
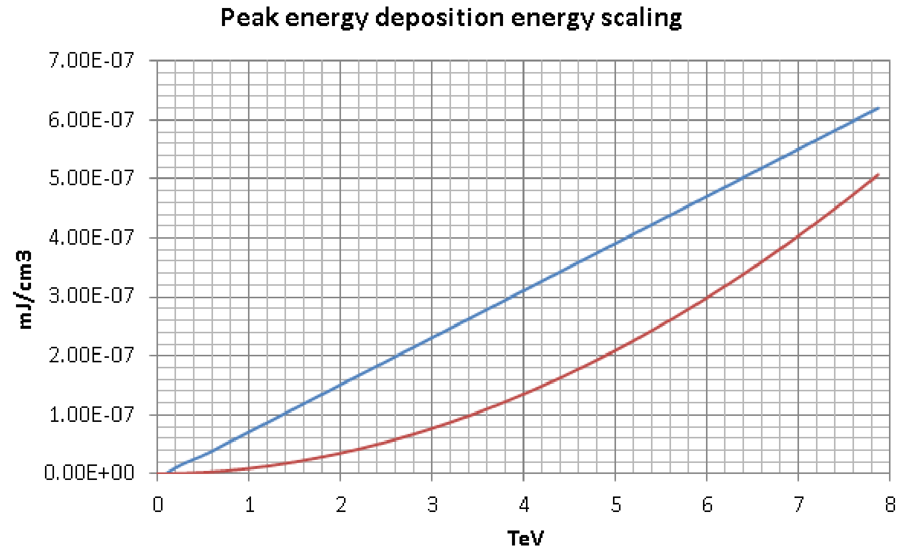


Figure: Energy density in the horizontal plane of MB.Axx due to beam-dust particle interactions in B1 (internal beam).

Comparison of MQ Position 1



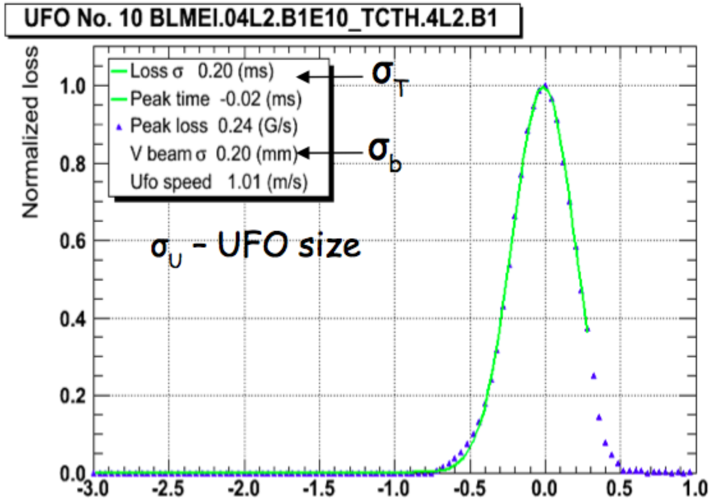


$$\text{BLMSignal@Quench}(E,t) = \frac{\text{BLMResponse}(E,t) * \text{QuenchLevel}(E,t)}{\text{EnergyDeposit}(E,t)}$$

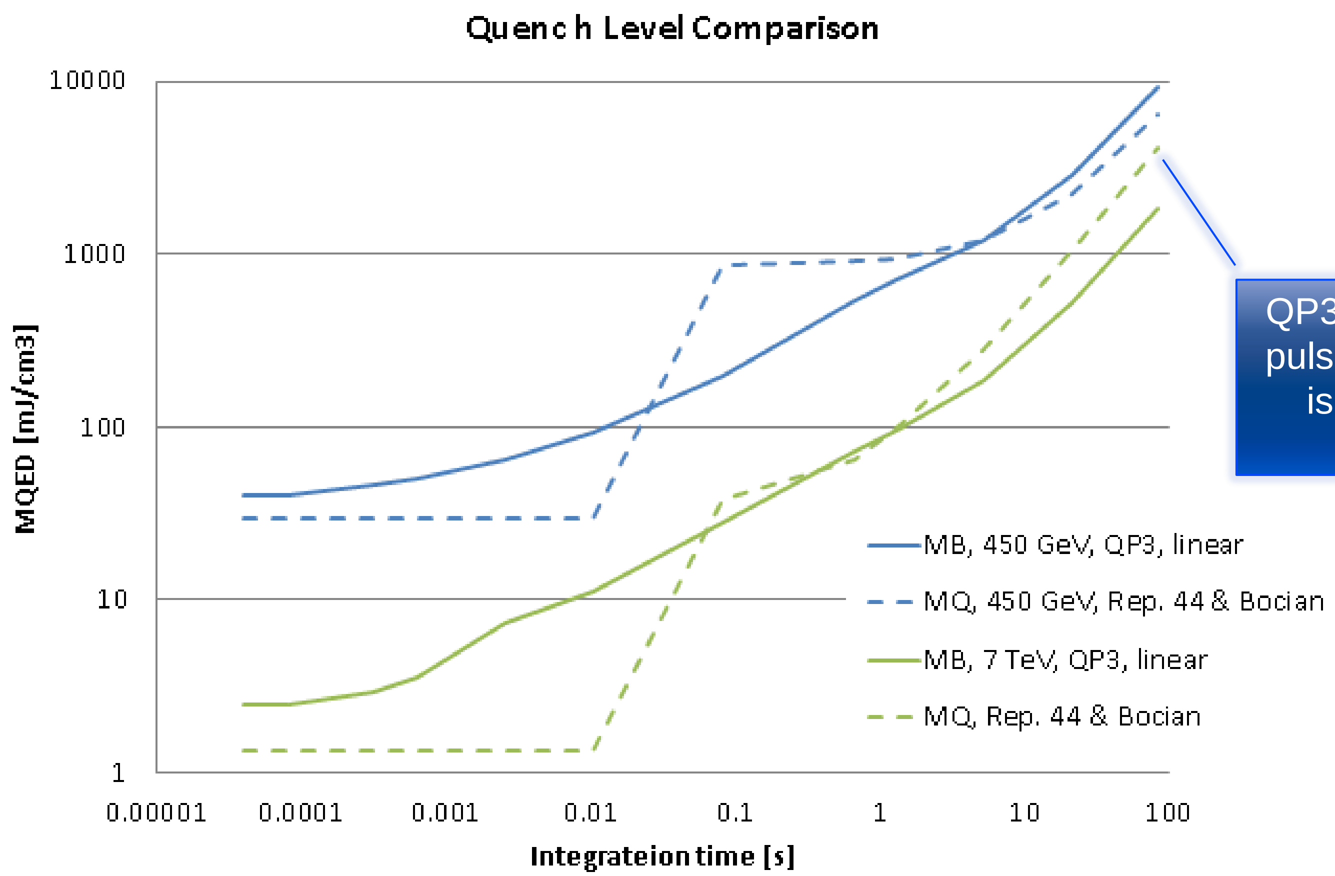
- BLM response: very flat scaling with energy. Much less signal at high energies.
- EnergyDeposit old/new ratio is very large at injection! (No neutral peak.)
- At high energies new BLMResponse/EnergyDeposit is smaller.
- At low energies new BLMResponse/EnergyDeposit is a lot larger.

Quench Level

- In the U.F.O. scenario, all BLMs are protecting MBs!
- U.F.O. time distribution is usually Gaussian.
- BLMs would trigger at peak or shortly after.
- Approximated by linearly rising losses over each RS.
- This reduces the quench level by ~2.
- (For the gas-leak scenario the validity of this assumption will depend on the cloud's diffusion velocity.)

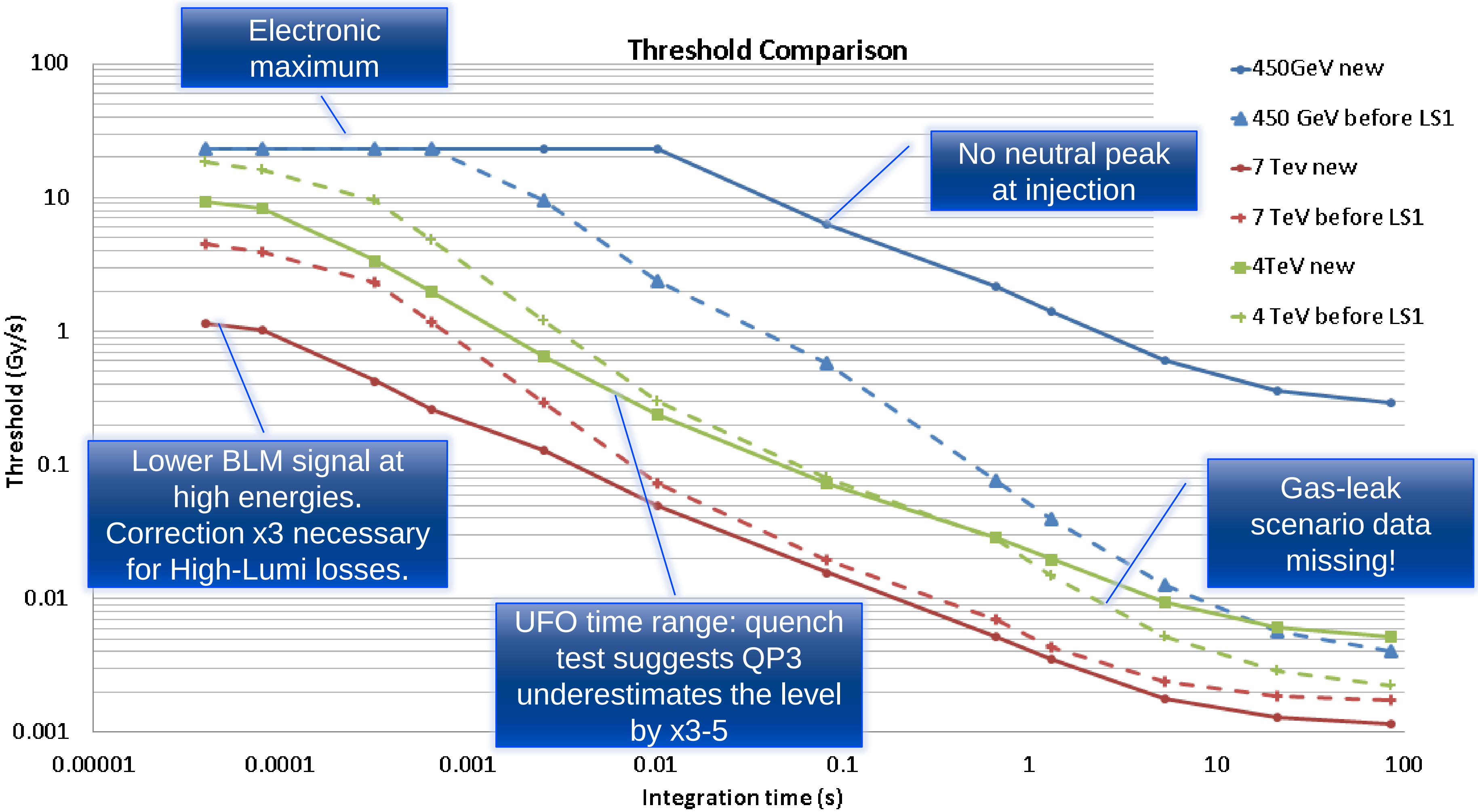


Quench Level

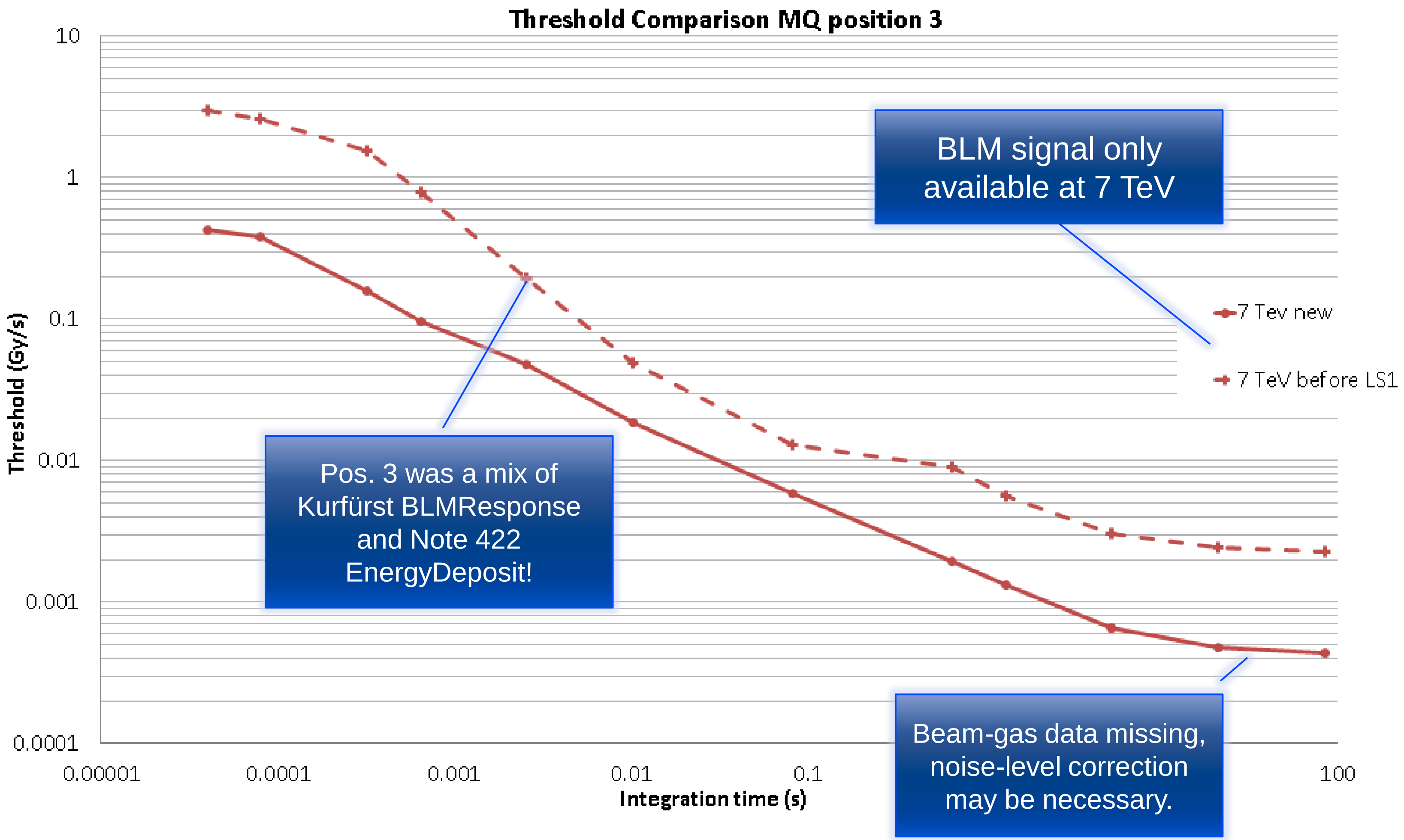


QP3 QL for rect. pulse and in MQ is 2x above Bocian!

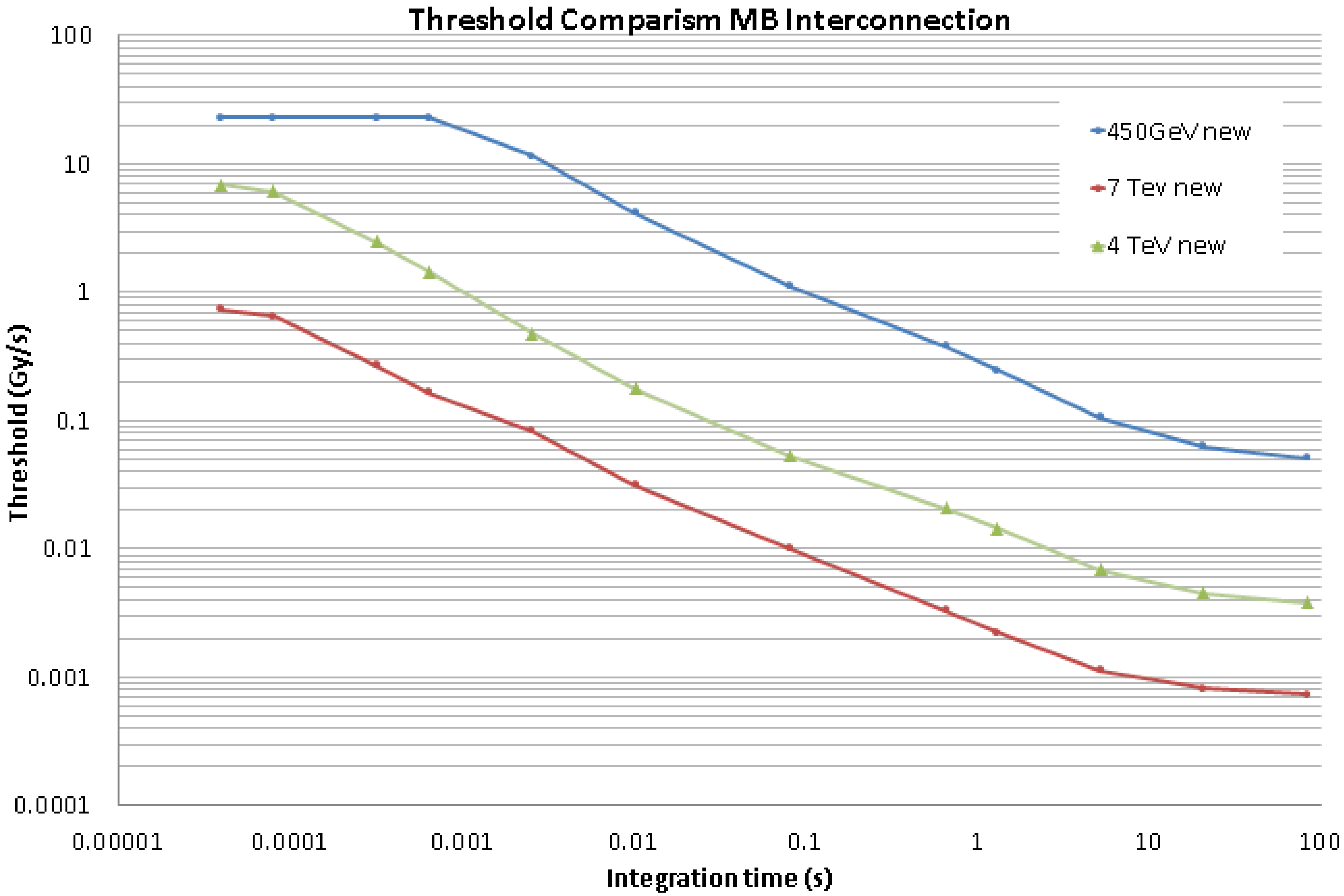
(Master)Thresholds old vs. new on MQ Position 1.



New Thresholds MQ Position 3



New Thresholds MB



Necessary Corrections

- Redo analysis of High-Lumi losses; increase thresholds in RS01-02 where necessary.
- U.F.O. time range: factor x 3-5 for QP3 underestimation.
- Introduce beam-gas scenario (prepare database for 2nd scenario).
- Long RSs:
  - Avoid problems with noise.
  - Cross-check with collimation loss maps, extrapolated to 500 kW.
- Monitor Factor:
  - Default 0.3 should correspond to predicted quench level, i.e., Master Threshold is 3x above expected signal at quench.

DS and SS strategy

- Use U.F.O. scenario up to RS06 (0.01 s).
- Use gas-leak scenario for RS07-RS12.
- Compute accurate quench levels
  - For all magnet types (in particular potted MQT magnets).
  - For the correct operation temperatures.
- Correct thresholds upwards if indicated by collimation loss-maps extrapolated to 500 kW for MF 1 in the concerned families.

Beyond Cryo-Magnets in Arc, DS, SS

- Collimator BLMs: Joint CWG, BLMTWG meeting in Aug. 14.
  - Review of threshold corrections since 2008.
  - Review of family compositions.
  - Review and update of Ralph's tables of maximum proton loss rates.
  - Review and update of the BLM signal / lost proton models.
- IT BLMs, first step:
  - Review of initial scenario and corrections since 2008.
- Warm magnets, first step:
  - Review max. allowable proton loss rates and corresponding BLM signals.
- LIBD, first step:
  - Contact responsible team.

Summary

- BLM thresholds for the protection of cryo magnets in arc, DS, and SS will be based on entirely new U.F.O. and beam-gas scenarios.
- No more orbit bump.
- Corrections
  - to allow for High-Lumi losses
  - for U.F.O. time-scale
  - to avoid noise levels
  - to allow for 200 (500) kW losses on primary collimators.
- Further steps needed in coming months to review all BLM families around the ring!

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