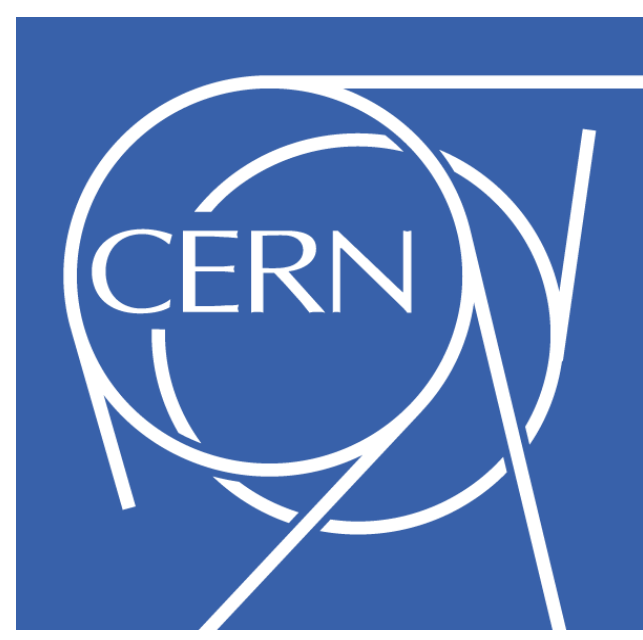


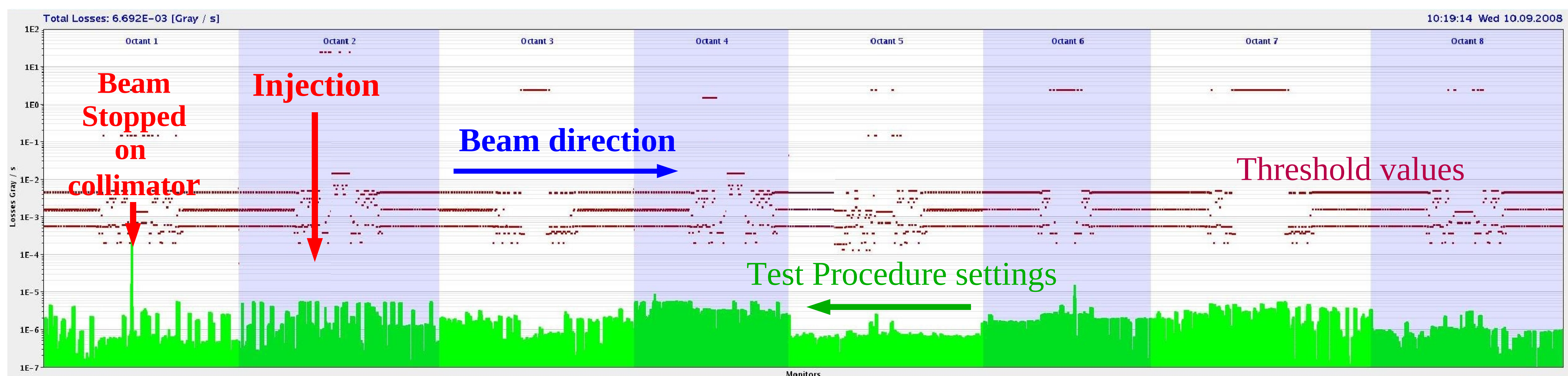


First Experience with the LHC Beam Loss Monitoring System

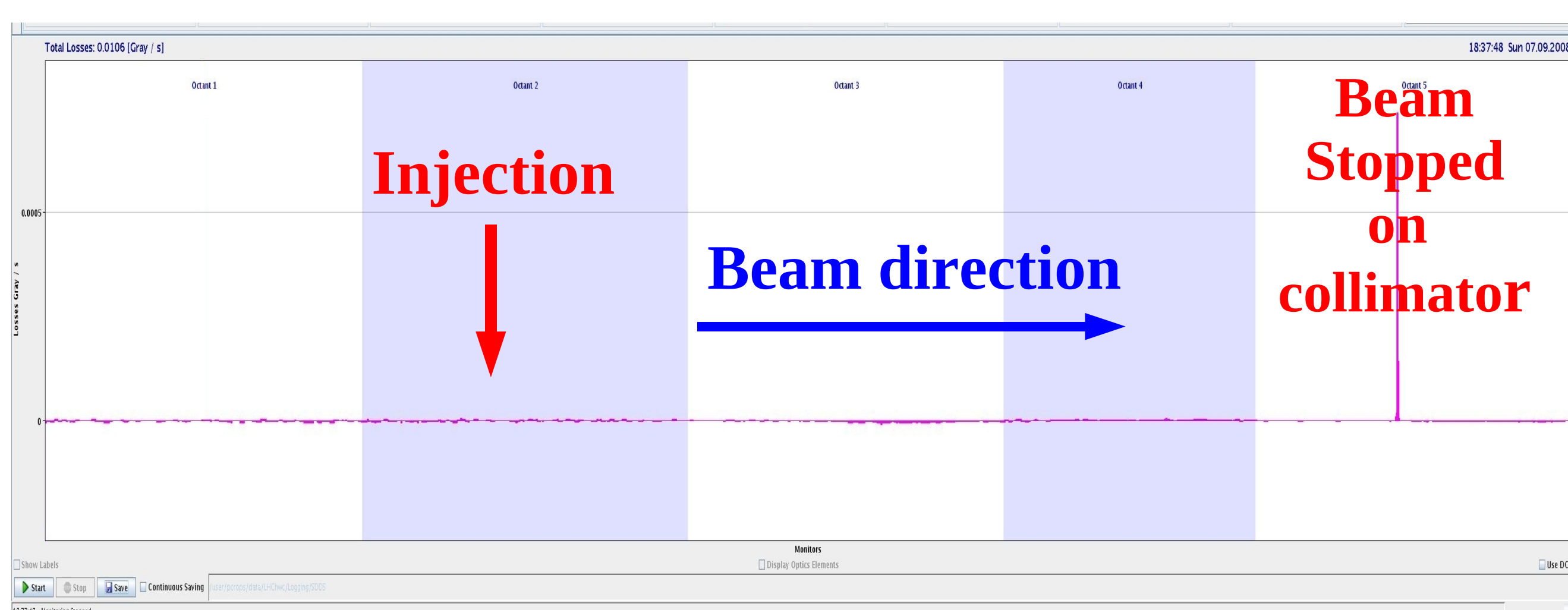
Bernd Dehning, Till Boehlen, Ewald Effinger, Jonathan Emery, Fabio Follin, Eva Barbara Holzer, Stephen Jackson, Daniel Kramer, Grzegorz Kruk, Pascal Le Roux, Julien Mariethoz, Marek Misiowiec, Laurette Ponce, Chris Roderick, Mariusz Sapinski, Christos Zamantzas (CERN), Markus Stockner (EBG MedAustron, Wr. Neustadt; CERN), Dariusz Bocian (Fermilab, Batavia; CERN), Viatcheslav Grishin (IHEP Protvino, Protvino, Moscow Region; CERN), Hitomi Ikeda (KEK, Ibaraki; CERN), Agnieszka Priebe (Poznan University of Technology, Poznan)

Abstract: The LHC beam loss monitoring system (BLM) consists of about 4000 monitors observing losses at all quadrupole magnets and many other likely loss locations. At the first LHC operation in August and September 2008 all monitors were active and used to observe the losses during the initial beam steerings, at collimators, at the LHC dump and during aperture scans. The different acquisition modes and their presentation are shown. Aperture scan loss patterns and a detailed loss pattern leading to a magnet quench are discussed. The observed signals of the BLM system are analyzed in terms of response time, sensitivity and noise performance.

Monitors and Thresholds

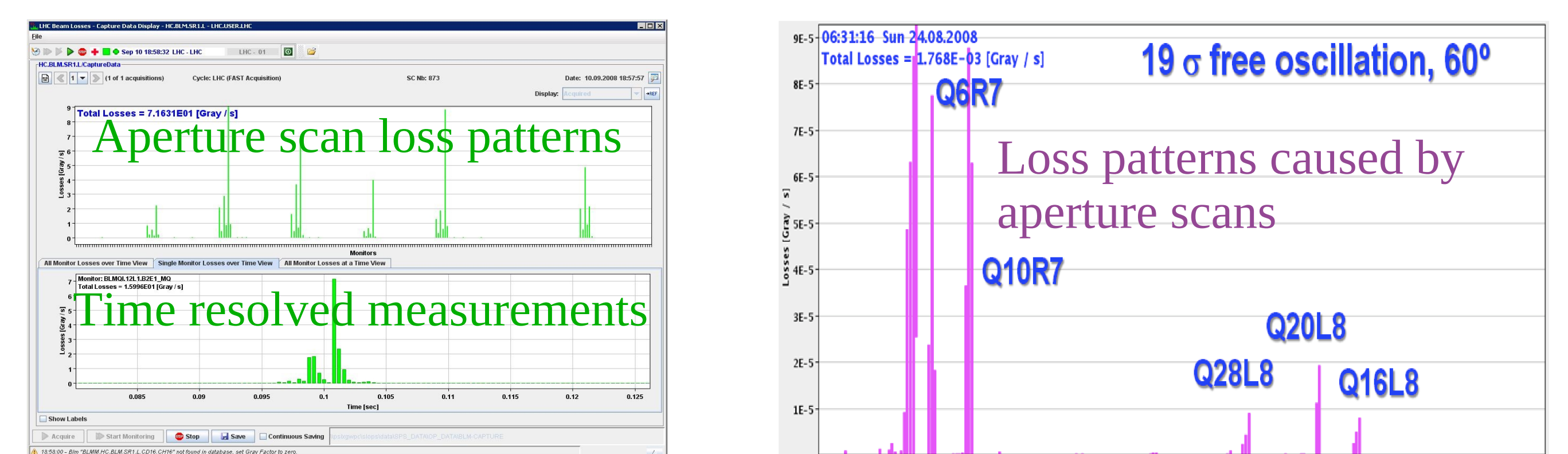


Relative Measurements



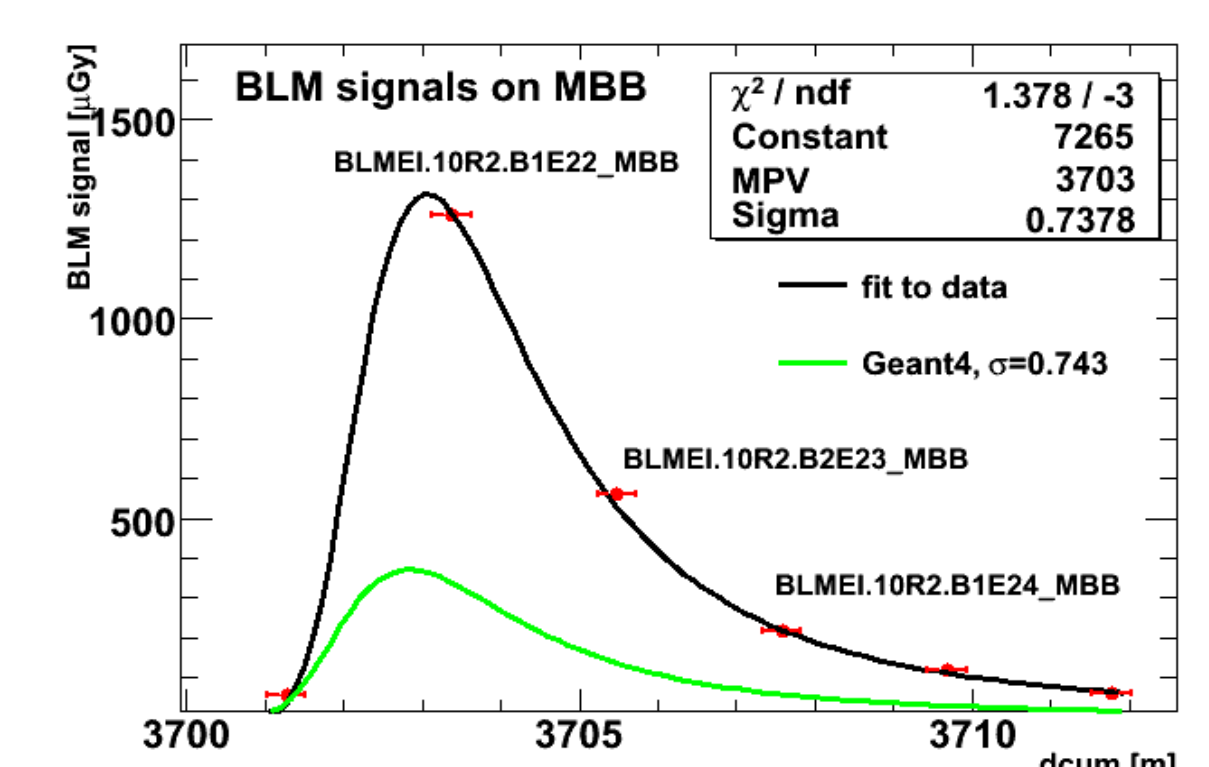
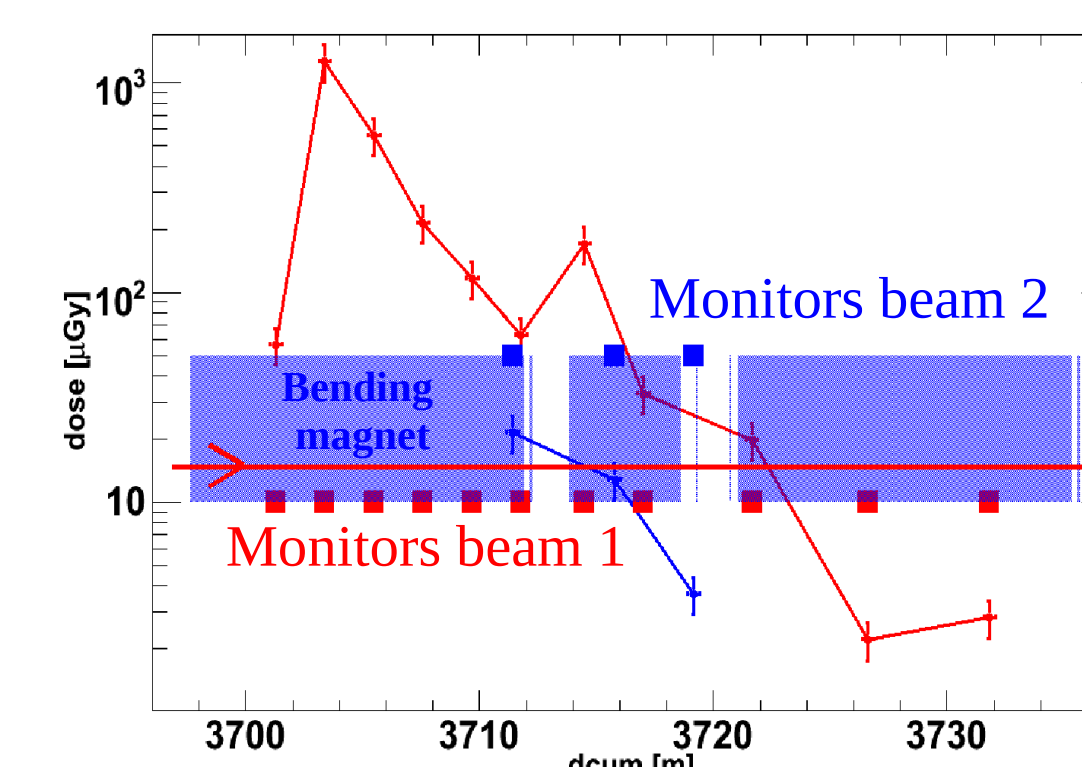
- Clean beam injection and dump of the beam on a collimator (TCT) left of CMS experiment
 - Injected intensity $5 \cdot 10^9$
 - Loss on collimators over 100 times larger as noise level of all other monitors shown (2500)
- ==>
- during injection process: prediction of losses can be done for intensities, which are 100 times larger (optimisation of injection process well below of quench levels)

Loss Patterns - First LHC Quench

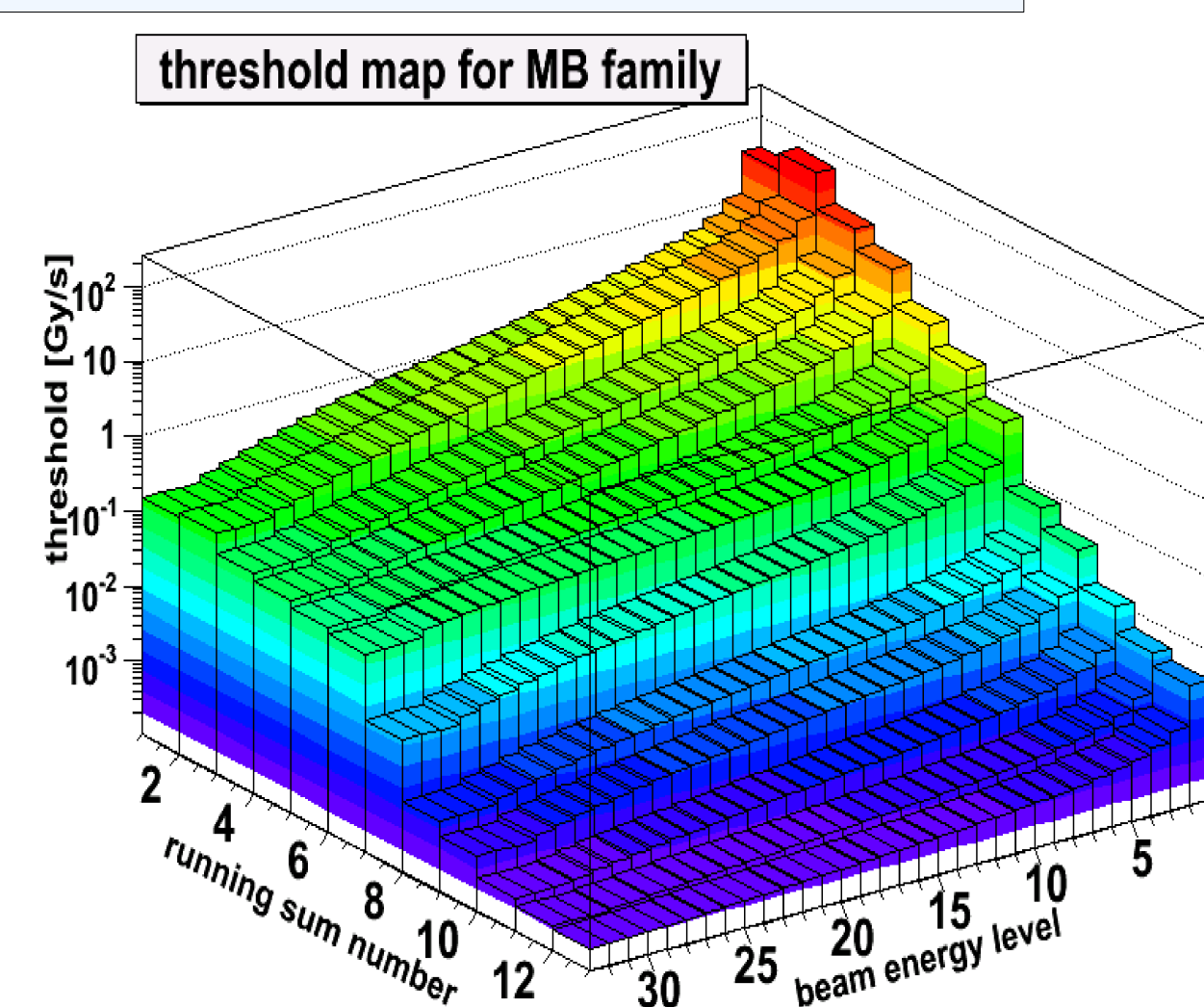
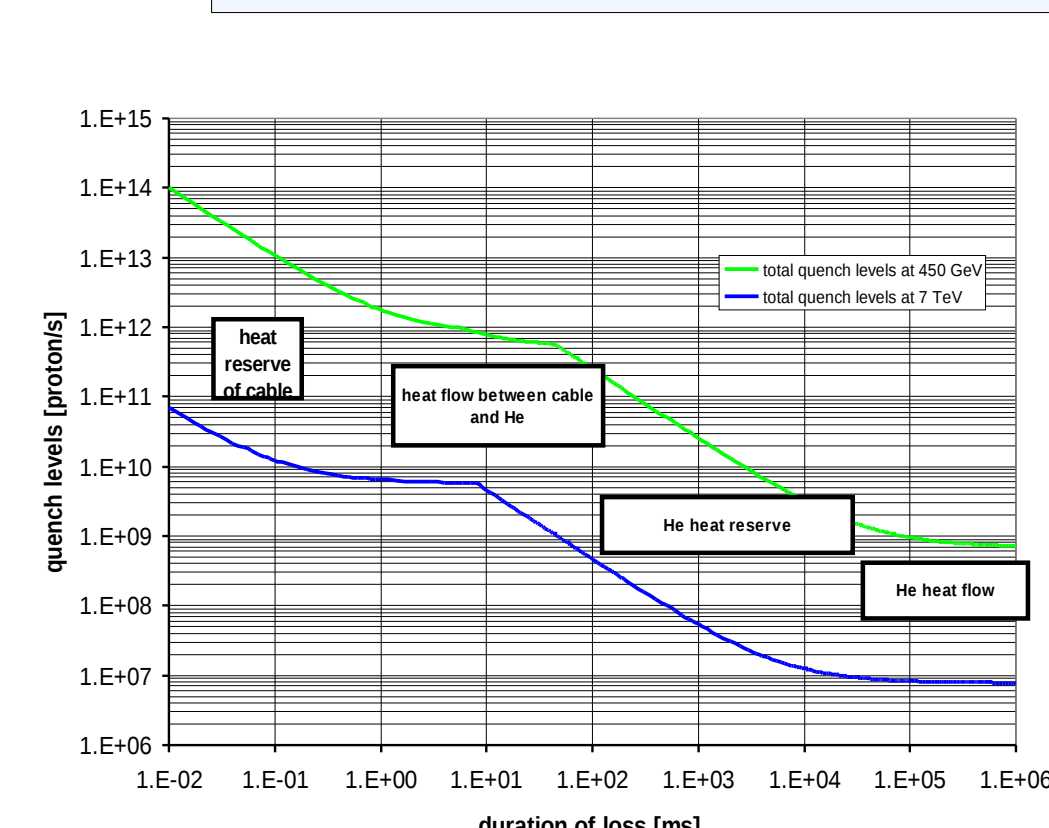


On-line display: 1.3s binning, 1 s update rate Capture data: 40 us and 2.5 ms binning
Loss causing Quench of bending magnet

Simulations <==> Threshold values



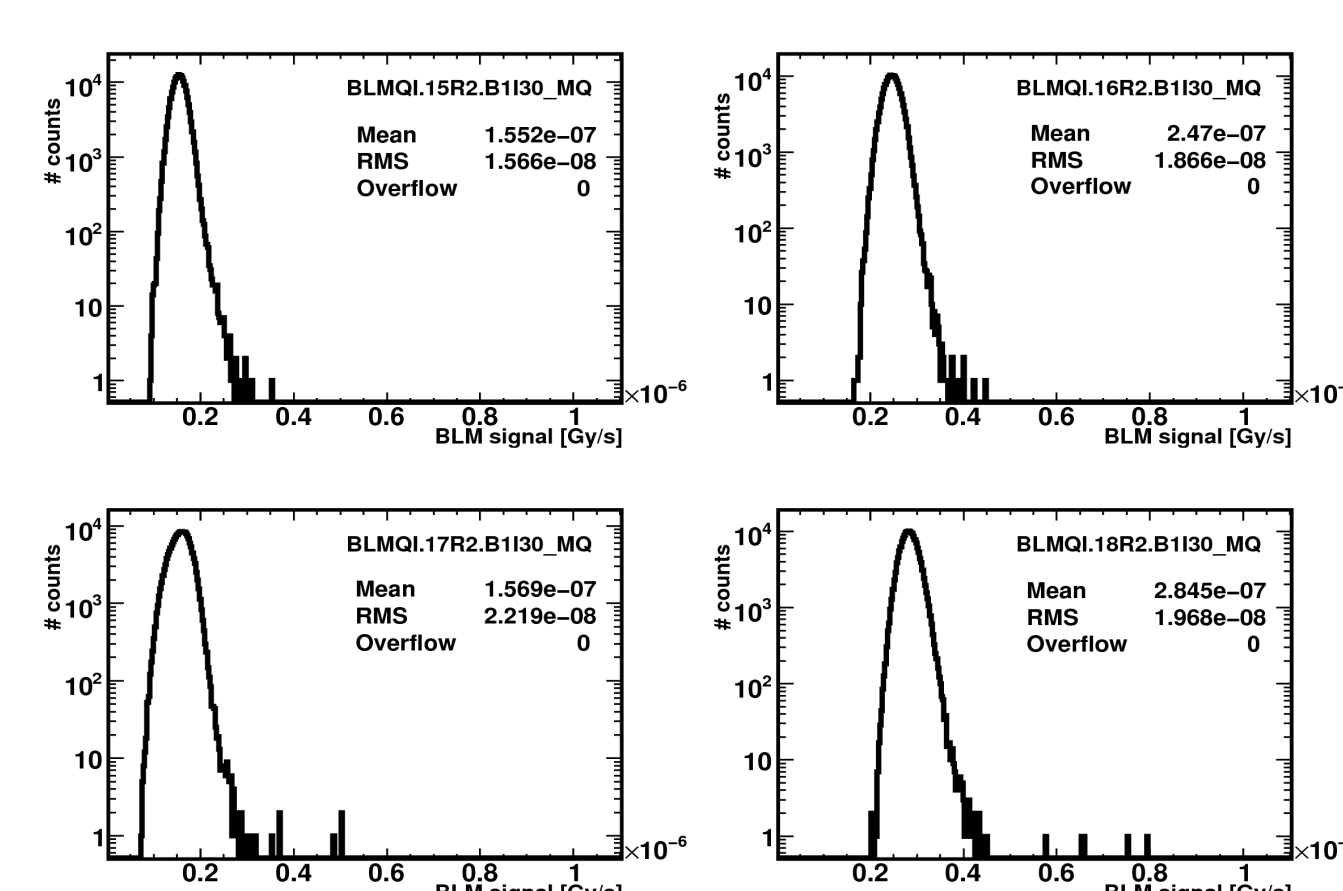
Threshold Settings



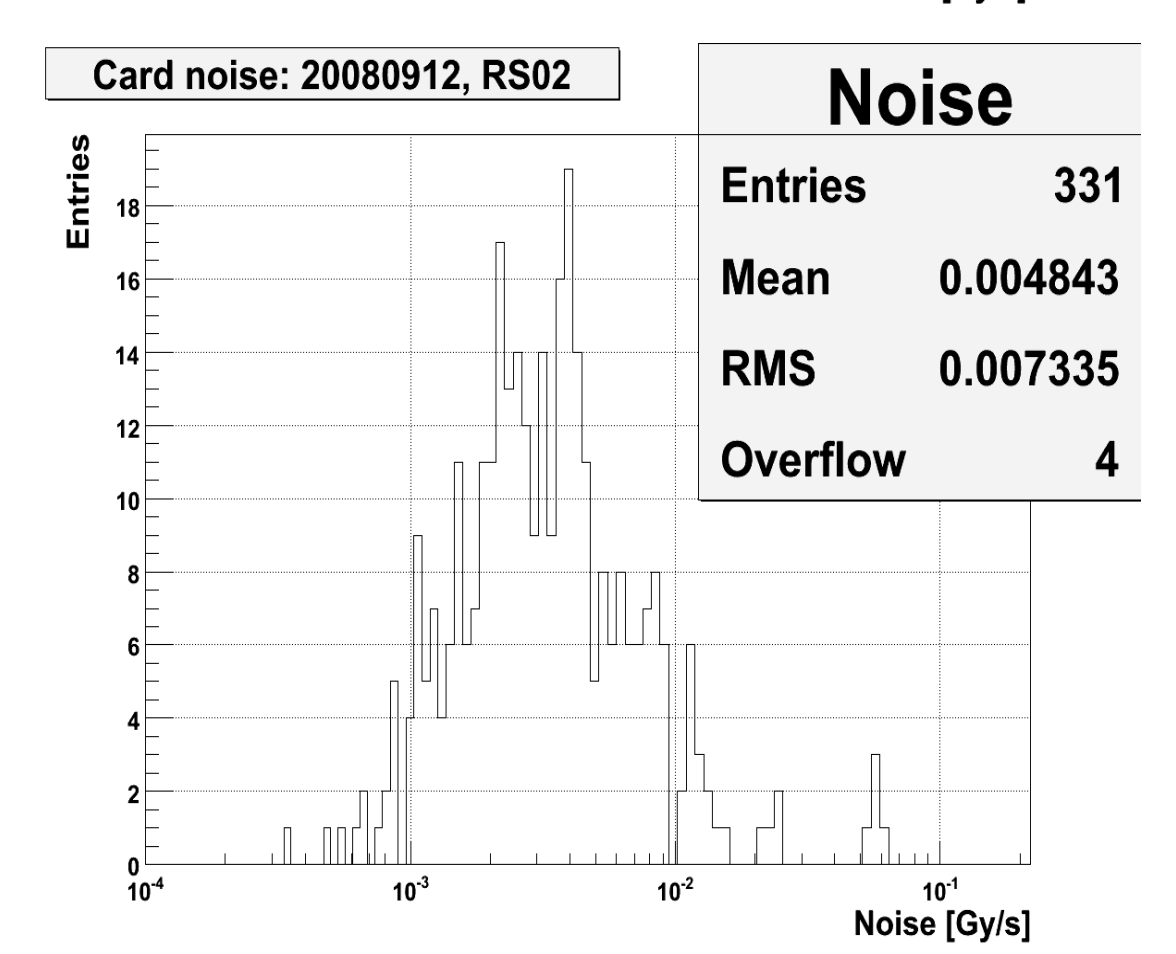
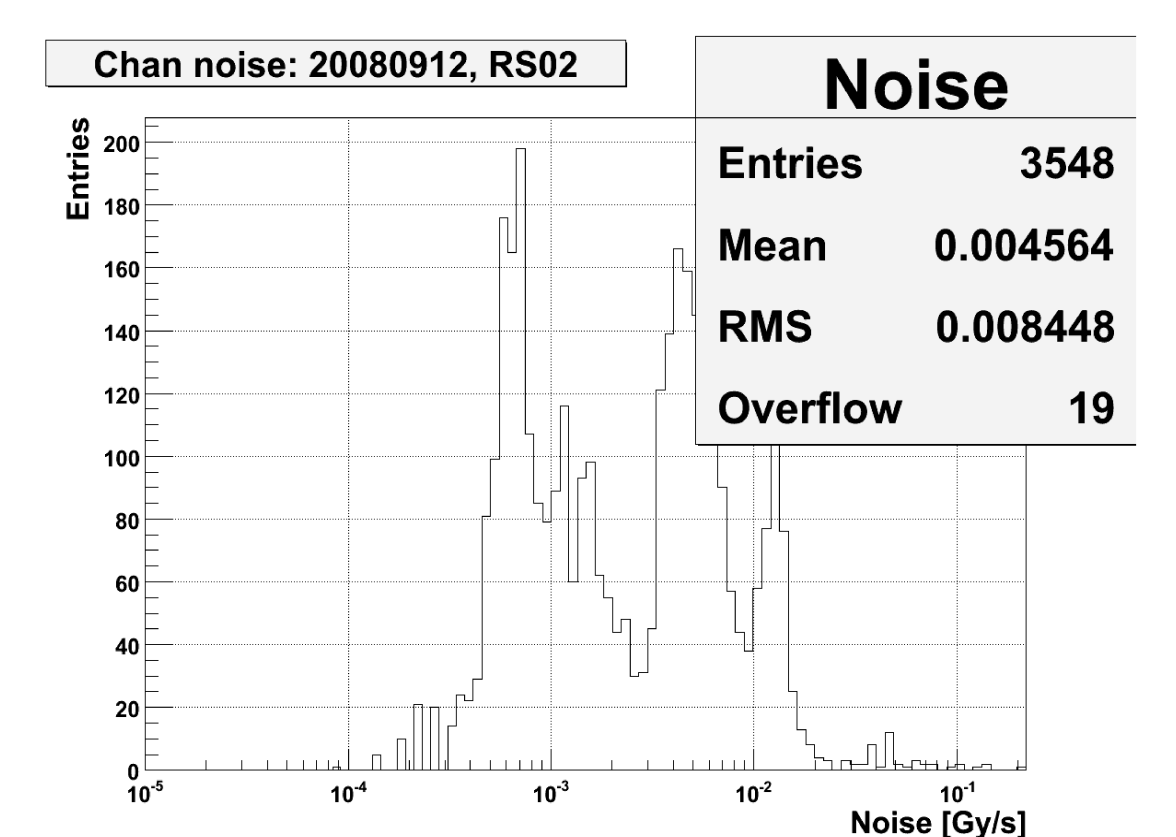
- Operation with maximal losses ==> Threshold settings follow beam energy automatically and quench level curve
- 32 energy steps
 - 246 GeV to 7.8 TeV
- 12 loss integration windows (running sums)
 - 40 us to 80 s
- Regular comparison of front-end settings with database



Acquisition Chain Signals



- To allow maximal protection ==> All channels are connected to the beam dump (No gain in reliability possible by coincidences)
- Check of noise levels by signal distribution recordings (single channel: above, whole system left)
- Channels with large fluctuation located on 4 electronic cards (12 September 2008)



Conclusion

- Observation of losses during the first injection studies and aperture scans
- Sensitivity to measure losses lower than 1 % of the pilot bunch intensity of $2 \cdot 10^9$
- Observed loss patterns are as expected
- No mayor faulty signals are introduced in the BLM acquisition chains (the number of false beam permit signal inhibits are expected to be low)