Stefano Redaelli, 16-02-2009

98th Meeting of the LHC Collimation Working Group, February 16th, 2009

Present: Oliver Aberle, Ralph Assmann (chairman), Giulia Bellodi, Chiara Bracco, Markus Brugger, Fritz Caspers, Bernd Dehning, Barbara Eva Holzer, Hitomi Ikeda, Daniel Kramer, Christoph Kurfuerst, Luisella Lari, Laurette Ponce, Valentina Previtali, Stefano Redaelli (scientific secretary), Stefan Roesler, Federico Roncarolo, Adriana Rossi, Mariusz Sapinski, George Smirnov, Jörg Wenninger.

Comments to the minutes

No comments to the previous minutes.

Agenda of this meeting

- BLM quench threshold estimates on the MB magnet (M. Sapinski)
- Trip report from Tevatron - crystal experiments (V. Previtali)

List of actions from this meeting

Action	People	Deadline
Is it possible to compensate for the BLM cable length in order to have correct measurements for short int. time (instead than modifying the bump thresholds)?	BLM team	2009 oper.

(Complete list at http://lhc-collimation.web.cern.ch/lhc-collimation/action.htm)

The next meeting will be March 2nd, 2009.
Provisional agenda (**http://lhc-collimation.web.cern.ch/lhc-collimation/**):
R. Assmann: Organization of the Phase II review
G. Bellodi: Ion collimation performance during energy ramp
F. Arnold-Malandain: New temperature sensors in IP3 and IP7

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Minutes of the meeting

1 A.O.B

- R. Assmann announced that a review of the collimation Phase II will take place at CERN on April 2nd and 3rd. The first announcement of this review was recently distributed around. R. Assmann encouraged everybody to pass on this information to whoever might be interested.

- In order to concentrate the collimation meetings it has been decided to combine the Phase II specification meeting with the collimation working group meeting, which will take place regularly every second week.

2 BLM quench threshold estimates on the MB magnet (M. Sapinski)

M. Sapinski presented his recent results on BLM quench threshold estimated for the LHC main dipole magnet. In particular, the simulation results were reviewed and compared with the real beam loss levels as measured during the beam-induced quenches at the LHC. Today's presentation covered the case of direct beam losses in LHC dipole magnets. A detailed note with Mariusz' results is under preparation: a draft is available upon request. In the following the aspects that triggered discussion are summarized.
M. Sapinski described the simulation set-up and stressed that a complete map of the magnetic field covering the full cross sections of the yoke has been included in simulations of energy deposition. At top energy, the energy deposited in the coil is larger by about a **factor 2** if the **contribution of the magnetic field** is taken into account. Responding to S. Redaelli, Mariusz commented that this result from simulation was not expected and that there is no mention of it in literature (for example in the Note 44 by J.B. Jeanneret).
There was some discussion about the **accuracy of the fit function** used to model the radial distribution of the energy deposited in the superconducting coil (see page 7). M. Sapinski believes that the error is of the order of **20-30 %**. On the other hand, he warned that the best fit was achieved with a $1/r$ function but there is no theory behind this choice (the magnet and field geometry are too complicated for analytical estimates) and hence there is no independent cross check to confirm this choice.
F. Caspers asked whether x-ray used for magnet/interconnect inspection could possibly quench the superconducting magnet, in case inspections were to be done with cold magnets (which does not seem to be a likely scenario). Mariusz said that he would need more information on the flux of x-rays in order to address this problem.
In order to calibrate the BLM reading with respect to the energy deposited in the coil, M. Sapinski simulated energy distribution and particle spectra outside the magnet cryostat, at the location of the BLMs. The simulated spectrum of particles distribution is multiplied by the BLM response functions for the various species to calculate the signal response. Mariusz warned that there are some **concerns** about the **contribution of neutrons**. This uncertainty might partially explain the observed differences between simulations and measurements and is therefore being investigated in collaboration with the FLUKA team.
The beam tests have shown that the **BLM measurements** for integration times below a few milliseconds is **systematic underestimated** (see page 20). This is due to the required charge collection time. R. Assmann asked if this error could be consistently **compensated in the electronics** rather then by just changing accordingly the threshold values (as it

is foreseen for the moment). This approach would have the advantage of compensating properly the contributions of different cable lengths for the different monitors whereas the change of thresholds would be an *ad hoc* solution that would not allow one to access the correct measurements. The BLM team will look into this possibility (**Action**).
Commenting to the statement that it was not easy to calculate the beam impact parameters for the first beam-induced quench, J. Wenninger suggested to **check the currents** of the **trim quadrupoles** that were found wrong for the first injection tested and were then corrected in the LSA database for the following tests.
R. Assmann asked if there are new estimates on **real quench limits** based on the beam measurements. Mariusz said the the conclusions of his study is that the "real" quench limit migh be about a **factor 2** lower than expetced (i.e. about 15 mJ/cc instead of 30 mJ/cc). that comparison so far have only be done for **instantaneous losses** and not for steady losses (more relevant for circulating beam operation). R. Assmann also commented that we did not reduce the beam intensity *until we did not quench anymore*, so we have no real lower limits. On the other hand, J. Wenninger reminded that we could safely lose full pilot beams of a few 1e9 protons during the circulating beam commissioning without quenching (the quenches with pilot beams could only be achieved with large impacting angles, that are difficult to achieve with circulating beams).
R. Assmann also stressed that for the first time we have an indication that **horizontal losses** seem to be significantly **more critical** than vertical losses. This aspect was overlooked so far and should be taken into account in the future.

3 BLM thresholds for the LHC collimators (V. Previtali)

V. Previtali presented a detailed review of beam experiments on **crystal collimation** (T-980 Crystal experiment) carried out at the Tevatron from October to December 2008. Valentina was visiting the laboratory for about two months and participated to these tests. This presentation was focused on the experimental results. In particular, Valentina presented various causes that could explain an observed discrepancy between expected and measured channeling angle (measured values are about a factor 2 smaller than expected). Details are given in Valentina's slides.
R. Assmann commented that the beam halo in Tevatron seemed very complicated to understand, suggesting that its behaviour deviates considerably from what is expected from linear optics. In addition, capture and un-captured beams show completely different behaviours. Following up this observation, we requested the BLM team to investigate the possibility of adding a **faster signal gating** in order to observe the losses from particles in the abort gap (as discussed in detail at the last collimation working group meeting of Dec. 12th, 2008).
R. Assmann also commented that the interpretation of beam data did not yet take into account the optics perturbation caused by the energy errors of un-captured halo particles. Simulations are on-going to model the dynamics of off-momentum beams.
G. Smirnov asked if the the effect of **amorphous layers** was estimated. V. Previtali responded that this effect is indeed taken into account in simulations. However this was not discussed in detail in this presentation on the beam measurements.
B. Dehning commented that a critical issue for crystal collimators is certainly the **channeling efficiency**. Were there any attempt to estimated? V. Previtali replied that the tests were focused on understanding the channeling angle and there was no time left to perform detailed studies on the channeling efficiency.

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