111th Meeting of the LHC Collimation Study Group

February 15, 2010

Present: R. Assmann (chairman), A. Rossi (scientific secretary), D. Wollmann, S. Redaelli, O. Aberle, E.B. Holzer, H. Day, S. Roesler, G. Bellodi, A. Dallocchio, A. Bertarelli, F. Carra, N. Mariani, L. Lari, V. Vlachoudis, L. Keller (SLAC), S. Lundgren (SLAC), J.C. Smith (SLAC), T. Markiewicz (SLAC), N. Mounet, J. Wenninger, R. Bruce, J-Ph. Tock, F. Caspers.
Excused: J. Jowett..

1 Comments to the minutes

No comments to the previous minutes.

2 Agenda of this meeting

1. Regular collimation status reports:
    a) Hardware and tunnel activities, if any
    b) Remote and beam commissioning
    c) Phase II activities at CERN
    d) Phase II activities at SLAC
    e) Cryo-collimators
    f) FLUKA work

2. Special reports :
    a) Measurements of tune shift induced by collimators (20') – N. Mounet, BE/ABP
    b) BLM – channels with filters (20') – E. B. Holzer, BE/BI
    c) Latest results on SLAC phase 2 collimators – FLUKA (20') – L. Lari, EN/STI

3 List of actions from this meeting

Action	**People**	**Deadline**
Check R/Q measurements	J. Smith	
Assess when (beam intensity) transverse damper has to be used. Assess at which beam energy the octupoles have to be switched on.	E. Metral	
Check integration of new SLAC Phase II collimator tank.	O. Aberle	
Provide details on the type of steel used for the SLAC tank.	SLAC	

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

The next meeting will be on March 1st.

Minutes of the meeting

1 Regular collimation status reports

1.1 Hardware and tunnel activities (O. Aberle EN/STI)

- Everything is closed and in good order.
- Last tests made on Friday 12th February, the collimation system is ready to start, including microphones electronics.

1.2 Remote and beam commissioning (R. Assmann BE/APB)

- Last week Ralph, Roderik and Daniel moved all collimators except the TCDQ's and the TCDIV.20607.
- Functions could not be run because the initial point of the functions did not correspond to the injection discrete settings. To be fixed.

1.3 FLUKA (V. Vlachoudis EN/STI)

- Simulations for 3.5TeV case are running.
- FLUKA people were puzzled by some results in the simulations, particles with $\Delta E/E \sim 33\%$. Ralph replied that it is possible, and the case could be looked at offline.
- The BLM's next to MBW's are not modeled. They will have to be introduced if we want to reproduce real measurements. Ralph added that D. Wollmann is going to rerun real cases.

1.4 Phase II activities at CERN (A. Bertarelli, EN/MME)

- Alessandro introduced two new members of his team working on collimations:
  - Nicola Mariani – PHD student in the FP7 framework project.
  - Federico Cara – fellow working on Phase II calculations.
- He announced a meeting planned for the 28th of February, on EuCArd- ColMat irradiation tests (EPFL, IP, GSI, CERN collaboration).
- Good progress in collimator design:
  - Installation of a prototype with BPM in the SPS.
  - Launch of the fabrication of the vessel, stiffener and jaw for the first Phase II prototype to be used as dummy for tests on the surface.
- A second prototype is foreseen to be built and installed in the HiRadMat facility.
- A third collimator with one jaw only will also be built and installed in HiRadMat. This collimator will be provided with widows to look (with a laser beam) in real time at vibrations and heating induced by the beam hitting the jaw.
- A design review will be planned shortly.

Ralph added that he needs inputs on budget requirements for medium term plan.
He is preparing the Eu-CARD/COLMAT work package.

1.5 Cryo-collimators installation (J-Ph. Tock TE/MSC)

- Jean-Philippe checked the alternative solution he presented in the previous meeting and reported that the transverse movement would bring the collimators inside the transfer-zone. This solution is therefore discarded.
- He also looked at the implication of 3m longitudinal movement of the DFBA and said that it would be at the limit of feasibility. He recommends to build either shorter collimators for this region or to reduce the length of the absorber sitting next to the DFBA. He also proposes to build correctors strong enough so to avoid moving elements transversally. John Jowett will have to check together with the re-matching of the optics.

1.6 Phase II activities at SLAC (J.C. Smith) – see slides

- The jaws are fully assembled.
- After the lowest longitudinal trapped modes have been measured for the new (simplified) transition region. Results show an increase in R/Q larger than a factor of 30.

Jeff is checking if this is compatible with running in the SPS.

Ralph commented that the design must be compatible with LHC, for which the collimators are designed, and asked what would be the consequences of such high impedance.
Jeff replied that the power load expected at the support at nominal LHC intensity is of the order of 700W, and >1kW at ultimate intensity.
Alessandro Bertarelli commented that 1kW in the support could be critical for the bearings.
Jeff said to be aware of the problem and looking for a solution.
Fritz showed doubts about the measurements, saying that a factor of 30 seems too high.
Jeff is going to present details in the next meeting.

2 Special topics

2.1 Tune shifts in the LHC from collimators impedance (N. Mounet BE/ABP) – see slides

N. Mounet presented a method to infer collimators impedance from Tune Shift measurements in the LHC.

- He estimated of Tune Shift caused by collimators in the LHC, for single bunch passage, as a function of the half gap.
- Non-linear effects can be neglected as long as the collimator jaw does not cut into the beam, i.e. when the gap is comparable to the beam size and the collimator causes considerable losses.
- Tune shift, even if all collimator are inserted, will be negligible (10^{-4}) for bunch population < 2.10^{10} p/b at 3σ half-gap, and population < 8.10^{10} p/b at 3σ half-gap.
- The tune instability threshold with lower for coupled bunch effects.

Ralph commented that we can measure down to 2σ (of the nominal beam emittance).
Ralph asked when it will be necessary to use the transverse damper.
He also asked at which beam energy it will be necessary to switch on the octupoles.

2.2 BLM for Collimation: Issues and Measures (E.B. Holzer BE/BI) – see slides

E.B. Holzer presented BLM measurements issues.

- The zero-level signal depends on the machine region, i.e. on the cable length.
- Some of the measurements with beam look like pick-up noise, still to be analysed.
- With beam, negative signals may appear at chambers that do not see losses but share the same cable as other chambers giving a real signal. These signals should be < -10pA.

Fritz asked where the bias is placed, and Barbara replied not on the cable but at the input of the acquisition electronics.
Fritz commented that if a cable with an empty channel would be good to understand the origin of the noise.
Alternatively one could disconnect a cable from the electronics and use an oscilloscope to measure the signal.

Barbara talked about beam interlock using BLM thresholds:

- She estimates that up to 5TeV there should not be many false dump triggers.
- She said that they are going to install new electronics that will improve the noise for SEM, but that will only happen in 4 years time.
- A resistor-capacitor delay (Daniel Kramer) to ICs is proposed as a solution to improve time response.

Ralph asked if the slower response could compromise the use of BLMs for protection. Jorg commented that a slow signal is better than no sensitivity.
Barbara said that in any case on uses the differential signal.
Ralph added that the filtered signal is ok for regular loss maps, but does not allow seeing spikes.

Barbara asked if it is possible to increase the beam dump threshold up to the collimator damage threshold.
Ralph said absolutely not, because the collimators are the most resistant elements in the machine. We should use a philosophy of non-local protection.
Barbara pointed out that the BLM cannot distinguish between losses coming from beam 1 or beam 2, and that each BLM was installed to protect a single element.
The discussion will be resumed off-line.

It was asked if electromagnetic signals could induce a disturbance and affect the beam interlock system, and the answer was no.

2.3 Latest results on SLAC phase 2 collimators (L. Lari EN/STI) – see slides

L. Lari on behalf of the FLUKA team presented the latest results on Phase II SLAC collimators, for which a new tank design was proposed.

- SLAC and CERN design were compared in terms of power deposition and residual dose rates. L. Lari showed a difference (CERN being larger) of the order of 2.3 kW (out of ~23kW) for 1 hour beam lifetime, considering all the Phase II components (i.e. jaws, supports, tanks, etc).
- In addition she estimated residual dose rates at about 50 cm from the collimator tank for an irradiation period of 185 days over one year operation. Luisella compared the dose at the Phase I collimator TCP.C6L7.B1 (the highest contributor for the Phase I, 4.5 mSv/h – EDMS 863919) with the dose at the Phase II collimator TCSM.A6L7.B1, and found a multiplication factor of 1.5 with the CERN design and of 0.8-1 with the SLAC design.

R. Assmann pointed out that the operational period is now of 2 years, followed by a 1 year shutdown. S. Roesler replied that after 2 months cooling time the two scenarios are equivalent, since the main isotopes are formed in the few months preceding the shutdown.
A. Bertarelli asked recommendation on how to improve the CERN design to lower dose rates, and, in particular, how large is the contribution of the jaw support and the tank materials. L. Lari replied that her analysis does not go into the details of the contribution of the support material, but that this could be done in future work.
SLAC stated that they use stainless steel, and will give details of the type of steel in the next meeting (given the strict CERN requirements for accelerator applications).
L. Lari pointed out that in her simulations she has not taken into consideration the turning of the SLAC jaws, thus the contribution could change and the gain could be lost.
After the meeting, the factor 1.5 was the object of further discussions. A factor of ~ 2 does not change anything from the handling point-of-view (given the dose rates of several mSv/h). Since the orientation of the collimators varies, the shielding power of jaws and tank is different for different layout and thus the contribution could change. A thinner tank (and Al) could be an option, but again the bulk-numbers would most probably not change significantly (given the fact that the 'shielding' effect of the tank is in competition with its source term). For RP optimization issues, obviously RP should be contacted (S. Roesler), including the related studies (if deemed necessary).