

# 117th Meeting of the LHC Collimation Study Group

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June 07, 2010

*Present:* R. Assmann (chairman), A. Rossi (scientific secretary), R. Bruce, D. Wollmann, A. Nordt, O. Aberle, G. Bellodi, J. Jowett, T. Markiewicz (SLAC), J. Smith (SLAC), E. Metral, J-Ph. Tock, A. Ryazanov, S. Redaelli, N. Mariani, J. Wenninger, A. Dallocchio.

*Excused:* A. Bertarelli, A. Masi.

## 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 integration and interfaces
  - f) FLUKA work
2. Special reports :
  - a) Update on IR3 combined cleaning study – A. Rossi, BE/ABP
  - b) Update on impedance – E. Metral, BE/ABP
  - c) Phase II in warm regions – O. Aberle, EN/STI

## 3 List of actions from this meeting

Action	People	Deadline
Matching studies for 4.5m displacement in IR3-DS.	J. Jowett	
Matching studies for IR7 and IR2 to check if same design as IR3 can be applied.	J. Jowett	
Follow up on SPS collimator activation.	O. Aberle	
Follow up on vacuum and cooling tests at SLAC.	O. Aberle	
Make sure that SLAC prototype (without ferrite) is compatible with the SPS installation.	E. Metral	
Impedance wire measurements on SLAC collimators.	E. Metral	
Effect of aperture model used for SixTrack simulation to be investigated.	A. Rossi and team	
Vertical impedance dominant for IR3 combined cleaning scheme?	E. Metral	Next meeting

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

The next meeting will be on June 21<sup>st</sup>.

# Minutes of the meeting

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## 1 Regular collimation status reports

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

- One of the LVDTs in IR3 gives noisy reading at beam flat top. This behaviour was already observed and almost everything in the data acquisition chain was replaced. During the next shut-down the connector of the cable on the LVDT will be checked. Otherwise the LVDT will have to be replaced.
- Differences difference between the motor controller position and LVDT reading  $>$  than 100  $\mu\text{m}$  were observed recently after power cut. The issued has been addressed and followed up by A. Masi in the weekly Collimator Operation meeting.

### 1.2 Remote and beam commissioning (S. Redaelli BE/OP and R. Assmann BE/APB)

- Orbit oscillations last week caused main losses on a secondary (loss of collimator hierarchy) – TCSG.A6R7.B2 – at relatively high intensity.
- The same happened with the TDI becoming primary and spraying over the arc.
- Ralph commented that if there are fast losses as observed, in order to avoid damaging collimators (tungsten collimators would not survive) operation should step down in intensity until the orbit is stabilised.
- Stefano pointed out that a beam dump was triggered by the BLM 1.3s threshold and asked the BLM people to follow up.

### 1.3 Phase II activities at CERN (A. Dallocchio)

- Ralph mentioned that the budget for Phase II has been requested by the directorate at the medium term planning meeting. Next year budget should be hopefully discussed on the 18<sup>th</sup> of June.
- Alessandro asked if the number of collimators to be produced for the 2012 installation has been fixed, and Ralph replied that it depends on the decision taken on the 18<sup>th</sup> of June.
- Ralph announced that at the end of June there will be a review of the Collimation Phase II project which should define what is required when. Given that so far the collimation system works as expected and given the level of losses observed, Ralph anticipate a strong motivation in installation of Phase II collimators, which should allow going up in intensity.
- E. Metral said that also the measured impedance of the collimation system is in good agreement with previous forecasts (see also the slides presented at <https://lhc-commissioning.web.cern.ch/lhc-commissioning/meetings/20100608/LHC-BC-WG-Min08June10.pdf>).

Alessandro presented the some results from the task force on [Collimators in the LHC Dispersion Suppressors](#) (see 6<sup>th</sup> meeting minutes).

- He invited everyone to post comments and suggestions for the design to contribute to the functional specifications.
- He pointed out that displacement in the DS they are requesting for is now 4.5m (instead of 3m). This will give margin both for the “cold” solution (requiring about 3.5m) and the “warm” solution (needing more room for the C/W transitions).
- J. Jowett was asked to make matching studies for this new proposal. Alessandro also asked that, besides IR3, the optics studies are made for IR7 and IR2 to check if they can apply the same design everywhere.

Studies for different jaw materials to be used for Phase II collimators are progressing:

- Full size jaws out of Cu-Diamond are being produced in Austria.
- Other Diamond composites are also being analysed.
- Samples of Silicon Carbide will be given to A. Ryazanov for radiation tests and offers have been ask for the production.

Phase II collimators installed in the SPS:

- Ralph mentioned that so far no test could be performed and asked Elias (as coordinator of the SPS MDs) if this could be done in the near future. He would like to see the difference between beam-based alignment (i.e. using BLM signals) and setting-up using the collimator BPMs and validate the concept.
- Oliver mentioned that the collimator in question is already radioactive (about 200  $\mu\text{Si}$ ). Ralph asked him to follow that up and check that this could not jeopardise the correct functioning of the collimator instrumentation.

#### 1.4 Phase II activities at SLAC (T. Markiewicz, SLAC) – see slides

- The assembly prototype collimator, including the tank, was completed (with flanges clamped and not welded) to measure the overall impedance. Unfortunately the measurements – with a wire moving back and forth – were not conclusive. They will be repeated directly at CERN.
- LHC collimators have been specified with ferrite to reduce the RF finger heating. Thomas said that he prefers not to put any ferrite in the collimator to be installed in the SPS, so to measure the impedance of the structure. Elias was asked to make sure that this will be compatible with the SPS installation.
- Torque measurements are in progress at SLAC (in collaboration with P. Gander, who is visiting at the moment).
- SLAC is not planning to make dedicated measurements of the axes rotation, since this can be reconstructed knowing the position of a facet with respect to a fiducial. The flatness of the jaws is not expected to change after mounting. Ralph commented that measurements of the absolute position of the jaws should be performed, as for all other collimators, and he asked to do them even if they cause delay in the delivery. SLAC is requested to give a time estimate for such measurement.
- Impedance wire measurements will be performed at CERN (as agreed with E. Metral).
- Cooling plates have not been welded yet. CERN believe they should be tested and Ralph asked Oliver to follow that up, together with the vacuum tests.

#### 1.5 Cryo-collimators integration and interfaces (J-Ph. Tock TE/MS) – see slides

Jean-Philippe showed the proposed layout in the DS region.

- As already mentioned, the requested displacement of machine elements will be of 4.5m instead of 3m, as indicated in the slides.
- The resulting CC will be 9.217 m long.

#### 1.6 FLUKA studies (F. Cerutti EN/STI)

- Setting up calculations for cryo-collimators, aimed at assessing power loads and doses on the X line and the bus-bars incorporated in the warm design – as provided by the A. Bertarelli's team – as well as the need of shielding the other beam line (the one not hosting the collimator), is ongoing.
- For the latter issue, beam-gas interaction looks as the relevant source term, whereas for the other simulations the beam characterization at the TCRYOA entrance (and the respective machine layout) provided last year by Thomas for the FLUKA studies presented at the review (being the only available tracking input to our knowledge) is being used.

## 2 Special topics

### 2.1 Simulations for 7TeV beam with IR3 combined cleaning and TCRYO (A. Rossi, BE/ABP) – see slides

A. Rossi presented her latest studies on IR3 combined cleaning and cryo-collimator.

- There seems to be clear advantages in running the machine with only one cleaning insertion region.
- For these simulations (ideal machine, without imperfections) :
  - o 1m graphite primary vertical collimator is put in place of the TCHSH mask.
  - o 4 x 1m graphite secondary vertical collimators are installed at the slots reserved for the Phase II TCSM (copper) collimators.

- 2 x 1m tungsten cryo-collimators are installed upstream Q8 and Q10 quadrupoles (w.r.t. the beam direction).
- Other machine elements have not been displaced nor does the optics have being re-matched.
- Results show that the configuration is promising, but that further investigation is required, since if the aperture model is updated, losses at D2 go above the quench limit.
- From the cleaning efficiency point of view, copper and tungsten cryo-collimators are equivalent.
- Losses at the tertiary collimators in the experimental regions are higher than with 2 cleaning insertion regions.

Ralph added that the system should be less sensitive to imperfections, whose effect is screened by the cryo-collimators.

## 2.2 LHC impedance and multi-bunch modes (E. Metral, BE/ABP) – [see slides](#)

*E. Metral* presented the latest results on impedance.

- Collimator impedance forecasts from last year (based on best guess values for many of the parameters) have been confirmed by recent measurements, within a factor of 2. The measurements scanned tune shift values as a function of collimator opening and bunch length (varied by scraping the beam with collimators).
  - At 3.5TeV the LHC beam is already unstable as predicted (see Elias's [presentation](#) at the LHC Commissioning WG on the 8<sup>th</sup> of June 2010). Both octupoles and feedback system have been used to try and stabilise it.
  - New studies on impedance of the IR3 combined cleaning scheme show that, contrary to what expected, the impedance could be worse than Phase II, despite the number of graphite collimators is lower. This could be due to the vertical collimators added in IR3. The matter will be investigated further and presented at the next CWG meeting. The answer is important for the end of June design review.
- Ralph added that we could reduce the number of vertical secondary collimators if necessary and see if the cleaning is still satisfactory.

## 2.3 PHASE II in the warm regions (O. Aberle, EN/STI) – [see slides](#)

*O. Aberle* presented what shall be done for Phase II in the room temperature regions.

- Plug ins, supports, water supply and cables are ready for the TCSM collimators that were foreseen for Phase II.
- If a vertical TCP in IR3 is installed in place of the TCHSH, the vacuum chamber around will have to be modified, because the TCP is longer.
- What needs to be done:
  - Install cables for collimator BMP
  - Align supports
  - Adjust cooling rate to new load
  - Install a clutch that decouples the motors and allows more accurate auto-retraction.
  - Modify the Roman Pots supports to allow installation of TCLP collimators.
  - Drill for support installation.
- Nothing has been foreseen so far for IR2 and IR6. Here the design of supports may have to be modified.
- Nothing has been foreseen so far for additional TCLs that could be necessary if FP420 is installed (see F. Roncarolo [presentation](#) on August 2009).

Oliver pointed out that new collimators can only be produced at CERN (12 to 18 month production time) and ask Ralph to give him a complete list of what is necessary to build.

He also mentioned that recovery of some of the collimator spares is going to take time because they are radioactive and should be handled in bld. 864 in Prévessin (space not yet provided).

Ralph asked Oliver to defend the space in Bld. 252: it should not disappear before new space is made available.